



Europäisches Patentamt
European Patent Office
Office européen des brevets



⑪ Publication number:

0 464 830 B1

⑫

EUROPEAN PATENT SPECIFICATION

⑯ Date of publication of patent specification: 29.11.95 ⑯ Int. Cl. 5: C07F 9/6506, A01N 57/16,
⑯ Application number: 91111152.4 C07F 9/6539, C07F 9/6521,
⑯ Date of filing: 04.07.91 C07F 9/653, C07F 9/59,
C07F 9/572, C07F 9/6512,
C07F 9/6544, C07F 9/6533

The file contains technical information submitted
after the application was filed and not included in
this specification

⑯ Organophosphorus compounds, method for preparing same and insecticides, acaricides and
nematocides containing same.

⑯ Priority: 06.07.90 JP 178825/90
08.04.91 JP 75327/91

⑯ Date of publication of application:
08.01.92 Bulletin 92/02

⑯ Publication of the grant of the patent:
29.11.95 Bulletin 95/48

⑯ Designated Contracting States:
CH DE FR GB IT LI NL

⑯ References cited:
EP-A- 0 175 985
EP-A- 0 192 060
EP-A- 0 277 317

⑯ Proprietor: AGRO-KANESHO CO., LTD.
No. 1-1, Marunouchi 3-chome
Chiyoda-ku
Tokyo (JP)

⑯ Inventor: Nanjo, Katsumi
1563-7, Shimoyasumatsu
Tokorozawa-shi,
Saitama-ken (JP)
Inventor: Kariya, Akinori
3-13-18, Hagiyama-cho
Higashi-Murayama-shi,
Tokyo (JP)
Inventor: Henmi, Shinya
3-36-8, Aoba-cho
Higashi-Murayama-shi,
Tokyo (JP)

⑯ Representative: VOSSIUS & PARTNER
Postfach 86 07 67
D-81634 München (DE)

EP 0 464 830 B1

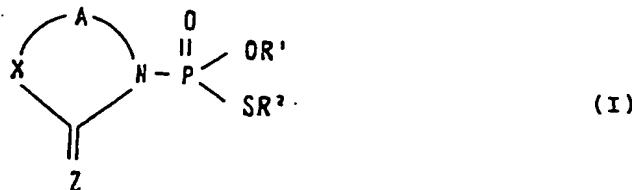
Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Description

The present invention relates to organophosphorus compounds represented by the following general formula (I):

5

10



15

[wherein R¹ and R² each represents a C₁ to C₄ alkyl group; X represents O, S, CH₂, CH-R³ (wherein R³ represents a C₁ to C₃ alkyl group), NH or N-R⁴ {wherein R⁴ represents a C₁ to C₄ alkyl group (the alkyl group may be substituted with at least one group selected from the group consisting of alkoxy, alkylthio, cyano, alkoxyalkyloxy and alkylamino groups and halogen atoms), an alkenyl group which may be substituted with halogen atoms, an alkynyl group which may be substituted with halogen atoms, a phosphoric acid ester radical, a cyano group, a group of the following general formula (II):

25



30

(wherein R⁵ represents an alkyl or alkylamino group which may be substituted with halogen atoms) or a group represented by the following general formula: -(R⁶)_n-CO-R⁷ (wherein n is 0 or 1; R⁶ represents a methylene group which may be substituted with alkyl groups, or an ethylene group which may be substituted with alkyl groups; R⁷ represents an alkyl group which may be substituted with halogen atoms, an alkoxy group which may be substituted with halogen atoms, an alkylthio group, an alkylamino group or a hydrogen atom); Z represents a group represented by the general formula: N-R⁸ (R⁸ represents a nitro group, a cyano group, an alkylsulfonyl group which may be substituted with halogen atoms, a tosyl group or an alkylcarbonyl group which may be substituted with halogen atoms) or a group represented by the general formula: C(CN)R⁹ (wherein R⁹ represents a cyano group or an alkoxy carbonyl group); and A represents an ethylene group which may be substituted with C₁ to C₃ alkyl groups, a trimethylene group which may be substituted with C₁ to C₃ alkyl groups or a group represented by the general formula: -CH₂NR¹⁰CH₂- (wherein R¹⁰ is a C₁ to C₃ alkyl group)]. The compounds of formula (I) according to the present invention specifically exclude organophosphorus compounds of the general formula (I) in which R¹ and R² are C₁ to C₄ alkyl groups respectively, X is NH, Z is a cyanoimino group or a nitroimino group and A is an ethylene group which may be substituted with C₁ to C₃ alkyl groups or a trimethylene group which may be substituted with C₁ to C₃ alkyl groups. The present invention also relates to a method for preparing the compounds of formula (I), and insecticides, acaricides and nematocides which comprise the compounds as an active ingredient.

Recently, organophosphorus compounds having an imidazolidinyl group have been investigated and developed. For instance, JP-A- 61-267594 and JP-A- 2-793 disclose that these compounds can be used as insecticides, acaricides, nematocides and agents for killing soil insect pests. However, these patents simply disclose organophosphorus compounds having an imidazolidine skeleton which carries an oxygen or sulfur atom on the 2-position. Moreover, the, insecticidal, acaricidal and nematocidal effects of these compounds are insufficient and are not necessarily satisfactory.

EP-A-0 277 317 discloses nitro or cyano derivatives of iminoimidazolidinyl useful as intermediates for insecticides.

Accordingly, an object of the present invention is to provide novel organophosphorus compounds represented by the foregoing general formula (I).

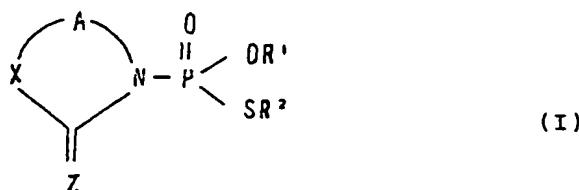
Another object of the present invention is to provide a method for preparing novel organophosphorus compounds represented by the foregoing general formula (I).

A further object of the present invention is to provide an agricultural chemical having insecticidal, acaricidal and nematocidal effects higher than those attained by conventional agricultural chemicals and exhibiting very low toxicity to warm-blooded animals.

These objects could be achieved on the basis of the finding that excellent control of harmful insect pests can be achieved by organophosphorus compounds (hereinafter referred to as "the compounds of the present invention") represented by the following general formula (I):

10

15



20 [wherein R¹ and R² each represents a C₁ to C₄ alkyl group; X represents O, S, CH₂, CH-R³ (wherein R³ represents a C₁ to C₃ alkyl group), NH or N-R⁴ {wherein R⁴ represents a C₁ to C₄ alkyl group (the alkyl group may be substituted with at least one group selected from the group consisting of alkoxy, alkylthio, cyano, alkoxyalkyloxy and alkylamino groups and halogen atoms), an alkenyl group which may be substituted with halogen atoms, an alkynyl group which may be substituted with halogen atoms, a phosphoric acid ester radical, a cyano group, a group of the following general formula (II):

25

30



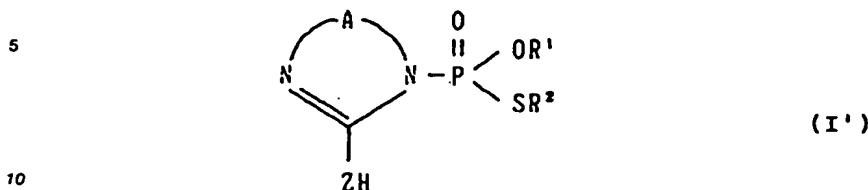
35 (wherein R⁵ represents an alkyl or alkylamino group which may be substituted with halogen atoms) or a group represented by the following general formula: -(R⁶)_n-CO-R⁷ (wherein n is 0 or 1; R⁶ represents a methylene group which may be substituted with alkyl groups, or an ethylene group which may be substituted with alkyl groups; R⁷ represents an alkyl group which may be substituted with halogen atoms, an alkoxy group which may be substituted with halogen atoms, an alkylthio group, an alkylamino group or a hydrogen atom}); Z represents a group represented by the general formula: N-R⁸ (R⁸ represents a nitro group, a cyano group, an alkylsulfonyl group which may be substituted with halogen atoms, a tosyl group or an alkylcarbonyl group which may be substituted with halogen atoms) or a group represented by the general formula: C(CN)R⁹ (wherein R⁹ represents a cyano group or an alkoxy carbonyl group); and A represents an ethylene group which may be substituted with C₁ to C₃ alkyl groups, a trimethylene group which may be substituted with C₁ to C₃ alkyl groups or a group represented by the general formula: -CH₂NR¹⁰CH₂- (wherein R¹⁰ is a C₁ to C₃ alkyl group)]. The compounds of formula (I) according to the present invention specifically exclude organophosphorus compounds of the general formula (I) in which R¹ and R² are C₁ to C₄ alkyl groups respectively, X is NH, Z is a cyanoimino group or a nitroimino group and A is an ethylene group which may be substituted with C₁ to C₃ alkyl groups or a trimethylene group which 50 may be substituted with C₁ to C₃ alkyl groups.

The terms "alkyl", "alkenyl" and "alkynyl" as used herein alone or as part of another group (e.g. alkoxy, alkylthio, alkylamino, alkylsulfonyl, alkylcarbonyl) include residues having 1 to 6, preferably 1 to 4 carbon atoms - as far as they are not defined otherwise.

These organophosphorus compounds do not give off any bad or irritating odor and have low toxicity to warm-blooded animals. Therefore, they can widely be used and thus have very high usefulness.

The organophosphorus compounds represented by the foregoing general formula (I) also include stereoisomers such as optical isomers. In addition, in the general formula (I), when X is the group NH, the organophosphorus compounds may exist in the form of a tautomer represented by the following general

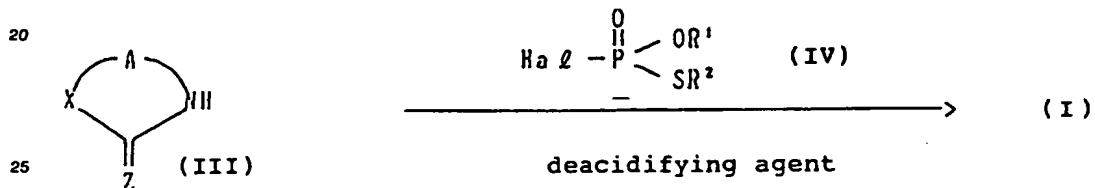
formula (I'):



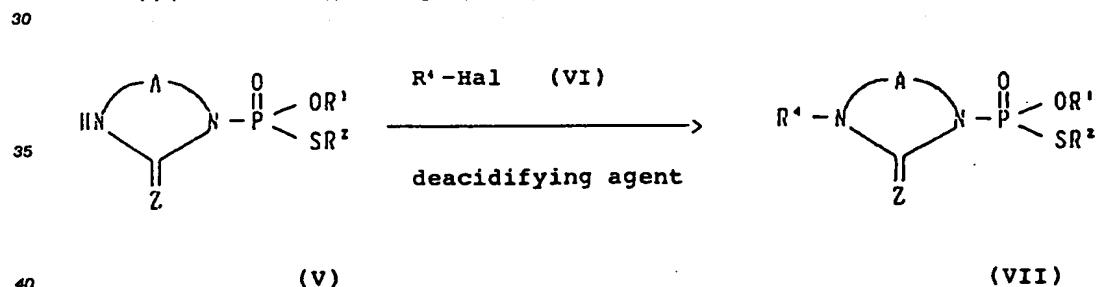
(wherein R¹, R², Z and A are the same as those defined above). These compounds (tautomeric isomers) are likewise included in the scope of the compound of the present invention.

15 The compounds of the present invention can be prepared in accordance with, for instance, any one of the following three methods.

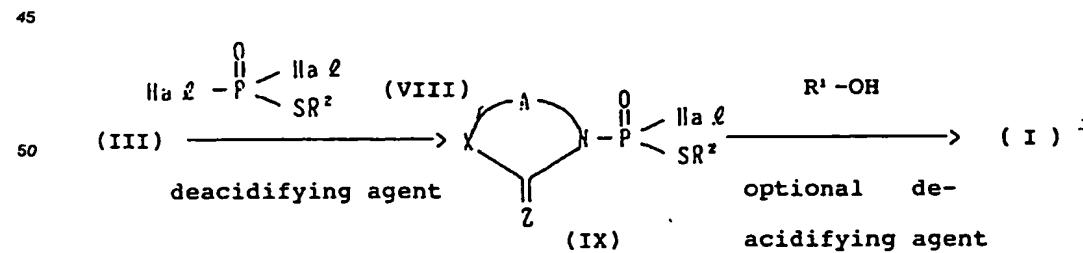
Method (i)



Method (ii) (in the formula (I), X is a group: NR⁴)



Method (iii)



55 (Wherein R¹, R², R⁴, X, Z and A are the same as those defined above and Hal means a halogen atom).

EP 0 464 830 B1

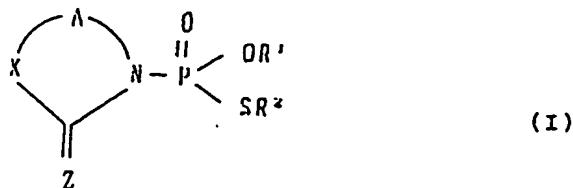
The foregoing reactions are in general carried out at a temperature ranging from -100 to +60° C and preferably from -80 to +30° C. Moreover, these reactions are performed in the presence of a deacidifying agent, examples of which include organic lithium compounds such as n-butyl lithium, t-butyl lithium and phenyl lithium; inorganic bases such as sodium hydride, potassium hydride, metallic sodium, sodium hydroxide and potassium hydroxide; alkoxides such as sodium methoxide, sodium ethoxide and potassium t-butoxide; and organic bases such as triethylamine and pyridine.

In addition, these reactions are desirably carried out in the presence of a solvent. Examples of such solvents include aromatic hydrocarbons such as benzene, toluene, xylene and chlorobenzene; cyclic or non-cyclic aliphatic hydrocarbons such as hexane and cyclohexane; ethers such as diethyl ether, methyl 10 ethyl ether, dioxane and tetrahydrofuran; nitriles such as acetonitrile, propionitrile and acrylonitrile; and aprotic polar solvents such as dimethylformamide, dimethylsulfoxide, sulfolane and hexamethyl-phosphoric acid triamide.

Typical examples of the compounds of the present invention will now be listed in the following Table 1. Each compound will hereinafter be described by the corresponding number of the compound.

15

20



25

In the following Table 1, the symbol "←A—" as set forth in the column "←A—" represents a bond with X and "ph" means a p-phenylene group.

Table 1-1

30

35

40

| Comp. No. | R ¹ | R ² | ←A— | X | Z | Physical Property |
|-----------|-------------------------------|---------------------------------|------------------------------------|-----------------------------------|-----------------------------------------|-------------------|
| 1 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₃ | N-NO ₂ | m.p.:46.0~48.0° C |
| 2 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-C ₂ H ₅ | N-NO ₂ | oily substance |
| 3 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₃ | N-CN | oily substance |
| 4 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-C ₂ H ₅ | N-CN | oily substance |
| 5 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-n-C ₃ H ₇ | N-CN | oily substance |
| 6 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-n-C ₄ H ₉ | N-CN | oily substance |
| 7 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | NH | C(CN) ₂ | oily substance |
| 8 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | NH | N-SO ₂ -ph-4-CH ₃ | oily substance |
| 9 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | NH | N-SO ₂ CH ₃ | oily substance |

45

50

55

Table 1-2

| Comp. | R ¹ | R ² | ← A — | X | Z | Physical |
|-------|-------------------------------|-----------------------------------|------------------------------------|------------------------------------------|-----------------------------------|--------------------|
| No. | | | | | | Property |
| 10 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | S | N-SO ₂ CH ₃ | oily substance |
| 11 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | S | N-CN | oily substance |
| 12 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | S | N-NO ₂ | oily substance |
| 13 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CH ₃ | N-CN | oily substance |
| 14 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-P(O)-S-n-C ₃ H ₇ | N-CN | oily substance |
| 15 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CH(CH ₃) ₂ | N-CN | oily substance |
| 16 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CH ₃ | N-CN | m.p.: 45.0~47.0° C |
| 17 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₃ | C(CN) ₂ | oily substance |
| 18 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₃ | C(CN) ₂ | oily substance |
| 19 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₃ | N-SO ₂ CH ₃ | oily substance |

Table 1-3

| Comp. | R ¹ | R ² | ← A — | X | Z | Physical |
|-------|-------------------------------|-----------------------------------|-------------------------------------|-------------------|--------------------|--------------------|
| No. | | | | | | Property |
| 20 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CH ₃ | C(CN) ₂ | m.p.: 73.0~76.0° C |
| 21 | C ₂ H ₅ | n-C ₃ H ₇ | -CH ₂ NCH ₃ - | NH | N-NO ₂ | oily substance |
| 22 | C ₂ H ₅ | n-C ₃ H ₇ | ditto | N-CH ₃ | N-NO ₂ | oily substance |

45

50

55

| | | | | | | | |
|----|-------------------------------|-----------------------------------|------------------------------------|--------------------------------------|------------------------------------|-----------------------------------|----------------|
| 23 | C ₂ H ₅ | n-C ₃ H ₇ | ditto | N-n-C ₃ H ₇ | N-NO ₂ | oily substance | |
| 24 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ CH=CH ₂ | N-NO ₂ | oily substance | |
| 5 | 25 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ | N-SO ₂ CF ₃ | oily substance |
| 26 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ CH=CH ₂ | N-CN | oily substance | |
| 10 | 27 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ C≡CH | N-CN | oily substance |
| 28 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-COCH ₃ | N-CN | oily substance | |
| 15 | 29 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CH ₂ OCH ₃ | N-CN | oily substance |

Table 1-4

| Comp. No. | R ¹ | R ² | ← A — | X | Z | Physical | |
|--------------|----------------|-------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------|----------------|
| | | | | | | Property | |
| 25 | 30 | C ₂ H ₅ | n-C ₃ H ₇ | CH ₃ -CHCH ₂ - | N-CH ₂ OC ₂ H ₅ | N-CN | oily substance |
| 31 | 31 | C ₂ H ₅ | n-C ₃ H ₇ | CH ₃ -CH ₂ CCH ₂ - CH ₃ | ditto | N-CN | oily substance |
| 32 | 32 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-SO ₂ N(CH ₃) ₂ | N-CN | oily substance |
| 33 | 33 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ SCH ₃ | N-CN | oily substance |
| 34 | 34 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ | NOOCF ₃ | oily substance |
| 35 | 35 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-C ₃ H ₇ | C(CN) ₂ | oily substance |
| 40 | 36 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-n-C ₃ H ₇ | C(CN) ₂ | oily substance |
| 37 | 37 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | NH | C(CN)COOC ₂ H ₅ | oily substance |
| 45 | 38 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ | C(CN)COOC ₂ H ₅ | oily substance |
| 39 | 39 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-C ₃ H ₇ | C(CN)COOC ₂ H ₅ | oily substance |

Table 1-5

EP 0 464 830 B1

| No. | Comp. | R ¹ | R ² | -A- | X | Z | Physical |
|-----|-------|-------------------------------|-----------------------------------|------------------------------------|---------------------------------------------------------------------|------|----------------------|
| | | | | | | | Property |
| 5 | 40 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | CH ₃ | N-CN | oily substance |
| | 41 | CH ₃ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CH ₃ | N-CN | m.p.: 76.0~80.0° C |
| 10 | 42 | C ₂ H ₅ | CH ₃ | -(CH ₂) ₂ - | N-CH ₃ | N-CN | m.p.: 116.0~118.5° C |
| | 43 | C ₂ H ₅ | C ₂ H ₅ | -(CH ₂) ₂ - | N-CH ₃ | N-CN | oily substance |
| | 44 | C ₂ H ₅ | iso-C ₄ H ₉ | -(CH ₂) ₂ - | N-CH ₃ | N-CN | oily substance |
| 15 | | | | CH ₃ | | | |
| | 45 | C ₂ H ₅ | sec-C ₄ H ₉ | -CH ₂ CH ₃ - | O | N-CN | oily substance |
| 20 | 46 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-COOCH ₃ H ₅ | N-CN | oily substance |
| | 47 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ CN | N-CN | oily substance |
| | 48 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-SO ₂ CH ₃ | N-CN | oily substance |
| 25 | 49 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ OCH ₃ CH ₂ OCH ₃ | N-CN | oily substance |
| | 50 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CO(NCH ₃) ₂ | N-CN | oily substance |

30

Table 1-6

| No. | Comp. | R ¹ | R ² | -A- | X | Z | Physical |
|-----|-------|-------------------------------|-----------------------------------|------------------------------------|-----------------------------------------|--------------------|--------------------|
| | | | | | | | Property |
| 35 | 51 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-n-C ₃ H ₇ | N-CN | oily substance |
| | 52 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ OCH ₃ | N-NO ₂ | oily substance |
| 40 | 53 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CH ₂ OCH ₃ | C(CN) ₂ | oily substance |
| | 54 | C ₂ H ₅ | sec-C ₄ H ₉ | -(CH ₂) ₂ - | N-CO-C(CH ₃) ₂ - | C(CN) ₂ | oily substance |
| | | | | CH ₂ C ₂ | | | |
| 45 | 55 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₂ CO- | N-CN | oily substance |
| | | | | C(CH ₃) ₂ | | | |
| 50 | 56 | C ₂ H ₅ | n-C ₃ H ₇ | -(CH ₂) ₂ - | N-CH ₃ | N-CN | m.p.: 58.5~61.5° C |

EP 0 464 830 B1

| | | | | | |
|----|-------------------------------|---------------------------------|-----------------------------------------------------|------------------|---------------------|
| 57 | C ₄ H ₉ | n-C ₃ H ₇ | -(CH ₂) ₃ -CH ₂ | N-CN | oily substance |
| 58 | C ₄ H ₉ | n-C ₃ H ₇ | -(CH ₂) ₃ -CHCH ₃ | N-CN | oily substance |
| 59 | C ₄ H ₉ | n-C ₃ H ₇ | -(CH ₂) ₃ -CH ₂ | NNO ₂ | oily substance |
| 60 | C ₄ H ₉ | n-C ₃ H ₇ | -(CH ₂) ₃ -CH ₂ | N-CN | m.p.: 44.0-47.0 ° C |

10

Table 2-1

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | IR (KBr): 1251 (P = O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.1 (m, 8H, OCH ₂ , CH ₃ , SCH ₂ CH ₂ -CH ₃), 2.7~3.2 (m, 2H, SCH ₂), 3.0 (s, 3H, NCH ₃), 3.8~4.5 (m, 6H, OCH ₂ , NCH ₂ CH ₂ N) |
| 2 | IR (neat): 1251 (P = O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.1 (m, 11H, OCH ₂ C H ₃ , SCH ₂ CH ₂ CH ₃ , NCH ₂ CH ₃), 2.7~3.75 (m, 4H, SCH ₂ , NCH ₂), 3.8~4.5 (m, 6H, OCH ₂ , NCH ₂ CH ₂ N) |
| 3 | IR (neat): 2176 (C = N), 1257 (P = O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.1 (m, 8H, OCH ₂ CH ₃ , SCH ₂ CH ₂ -CH ₃), 2.7~3.2 (m, 2H, SCH ₂), 3.3 (s, 3H, NCH ₃), 3.5~4.5 (m, 6H, OCH ₂ , NCH ₂ CH ₂ N) |

Table 2-2

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | IR (neat): 2176 (C = N), 1257 (P = O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.1 (m, 11H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃ , NCH ₂ CH ₃), 2.7~3.2 (m, 2H, SCH ₂), 3.5~4.5 (m, 8H, OCH ₂ , NCH ₂ CH ₂ N, NCH ₂) |
| 5 | IR (neat): 2170 (C = N), 1257 (P = O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.1 (m, 13H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₃), 2.7~3.2 (m, 2H, SCH ₂), 3.4~4.5 (m, 8H, OCH ₂ , NCH ₂ CH ₂ N, NCH ₂) |
| 6 | IR (neat): 2170 (C = N), 1257 (P = O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.1 (m, 15H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₂ CH ₃), 2.7~3.2 (m, 2H, SCH ₂), 3.5~4.5 (m, 8H, SCH ₂ , NCH ₂ CH ₂ N, NCH ₂) |

45

50

55

EP 0 464 830 B1

Table 2-3

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7 | IR (neat): 3232 (NH), 2194 (C = N), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.1 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.7~3.2 (m, 2H, SCH_2), 3.5~4.5 (m, 6H, OCH_2 , $\text{NCH}_2\text{CH}_2\text{N}$), 8.00 (bs, 1H, NH) |
| 8 | IR (neat): 3376 (NH), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.1 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{CH}_2\text{CH}_3$), 2.36 (s, 3H, Ph-CH_3), 2.6~3.1 (m, 2H, SCH_2), 3.4~4.4 (m, 6H, OCH_2 , $\text{NCH}_2\text{CH}_2\text{N}$), 7.1~7.9 (m, 5H, NH, benzene) |
| 9 | IR (neat): 3370 (NH), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.1 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.7~3.2 (m, 2H, SCH_2), 2.93 (s, 3H, SO_2CH_3), 3.5~4.5 (m, 6H, OCH_2 , $\text{NCH}_2\text{CH}_2\text{N}$), 7.34 (bs, 1H, NH) |

Table 2-4

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 | IR (neat): 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.1 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.7~3.5 (m, 4H, SCH_2 , $\text{SCH}_2\text{CH}_2\text{N}$), 2.99 (s, 3H, SO_2CH_3), 3.9~4.5 (m, 4H, OCH_2 , $\text{SCH}_2\text{CH}_2\text{N}$) |
| 11 | IR (neat): 2176 (C = N), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.1 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{CH}_2\text{CH}_3$), 2.7~4.7 (m, 8H, SCH_2 , $\text{SCH}_2\text{CH}_2\text{N}$, OCH_2) |
| 12 | IR (neat): 1251 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.1 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.7~3.4 (m, 4H, SCH_2 , $\text{SCH}_2\text{CH}_2\text{N}$), 4.0~4.6 (m, 4H, OCH_2 , $\text{SCH}_2\text{CH}_2\text{N}$) |

Table 2-5

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13 | IR (neat): 2176 (C = N), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.2 (m, 13H, OCH_2CH_3 , $\text{SCH-(CH}_3\text{)CH}_2\text{CH}_3$, $\text{NCH}_2\text{CH}_2\text{CH}_2\text{N}$), 3.1~4.5 (m, 7H, SCH , OCH_2 , $\text{NCH}_2\text{CH}_2\text{CH}_2\text{N}$), 3.35 (s, 3H, NCH_3) |
| 14 | IR (neat): 2182 (C = N), 1266 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.1 (m, 16H, OCH_2CH_3 , $\text{OCH}_2\text{-CH}_3$, $\text{SCH}_2\text{CH}_2\text{CH}_3$, $\text{SCH}_2\text{CH}_2\text{CH}_3$), 2.6~3.2 (m, 4H, SCH_2 , SCH_2), 3.9~4.5 (m, 8H, OCH_2 , OCH_2 , $\text{NCH}_2\text{CH}_2\text{N}$) |
| 15 | IR (neat): 2176 (C = N), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 17H, OCH_2CH_3 , $\text{SCH-(CH}_3\text{)CH}_2\text{CH}_3$, $\text{N-CH(CH}_3\text{)}_2$), 3.2~4.5 (m, 7H, SCH , $\text{NCH}_2\text{-CH}_2\text{N}$, OCH_2), 4.7~5.2 (m, 1H, NCH) |

Table 2-6

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 16 | IR (neat): 2176 (C = N), 1254 (P = O) cm $^{-1}$ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 11H, OCH ₂ CH ₃ , SCH-(CH ₃)CH ₂ CH ₃), 3.20~4.5 (m, 7H, SCH, NCH ₂ CH ₂ N, OCH ₂), 3.32 (s, 3H, NCH ₃) |
| 10 17 | IR (neat): 2200 (C = N), 1263 (P = O) cm $^{-1}$ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 8H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃), 2.1~3.7 (m, 8H, NCH ₂ CH ₂ CH ₂ N, SCH ₂), 3.35 (s, 3H, NCH ₃), 3.9~4.5 (m, 2H, OCH ₂) |
| 15 18 | IR (neat): 2200 (C = N), 1269 (P = O) cm $^{-1}$ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 8H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃), 2.6~4.5 (m, 8H, SCH ₂ , NCH ₂ CH ₂ N, OCH ₂), 3.30 (s, 3H, NCH ₃) |

Table 2-7

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20 19 | IR (neat): 1617 (C = N)cm $^{-1}$ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 8H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃), 2.6~4.5 (m, 8H, SCH ₂ , NCH ₂ CH ₂ N, OCH ₂), 2.97 (s, 3H, SO ₂ CH ₃), 3.30 (s, 3H, NCH ₃) |

Table 2-8

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 30 20 | IR (KBr): 2200 (C = N), 1265 (P = O) cm $^{-1}$ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 11H, OCH ₂ CH ₃ , SCH-(CH ₃)CH ₂ CH ₃), 3.20~4.5 (m, 7H, SCH, NCH ₂ CH ₂ N, OCH ₂), 3.30 (s, 3H, NCH ₃) |
| 35 21 | IR (neat): 3274 (NH), 1248 (P = O) cm $^{-1}$ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 8H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃), 2.56 (s, 3H, NCH ₃), 2.70~3.20 (m, 2H, SCH ₂), 3.9~4.7 (m, 6H, OCH ₂ , NCH ₂ N, NCH ₂ N), 9.49 (bs, 1H, NH) |
| 40 22 | IR (neat): 1248 (P = O) cm $^{-1}$ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 8H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃), 2.58 (s, 3H, NCH ₃), 3.0 (s, 3H, NCH ₃), 2.70~3.2 (m, 2H, SCH ₂), 3.8~4.5 (m, 6H, NCH ₂ N, NCH ₂ N) |

45

50

55

EP 0 464 830 B1

Table 2-9

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|----------------------------|
| 5 | |
| 10 | |
| 15 | |
| 20 | |
| 25 | |
| 30 | |
| 35 | |
| 40 | |
| 45 | |
| 50 | |
| 55 | |

Table 2-10

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|----------------------------|
| 25 | |
| 30 | |
| 35 | |
| 40 | |
| 45 | |
| 50 | |
| 55 | |

Table 2-11

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 30 | IR (neat): 2182 (C = N), 1260 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 14H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$, OCH_2CH_3 , $\text{NCH}(\text{CH}_3)\text{CH}_2\text{N}$), 2.7~4.5 (m, 9H, SCH_2 , OCH_2 , OCH_2 , $\text{NCH}(\text{CH}_3)\text{CH}_2\text{N}$), 5.14 (s, 2H, NCH_2O) |
| 31 | IR (neat): 2176 (C = N), 1272 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 17H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$, OCH_2CH_3 , $\text{NCH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{N}$), 2.6~4.5 (m, 10H, SCH_2 , OCH_2 , OCH_2 , $\text{NCH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{N}$), 5.16 (s, 2H, NCH_2O) |
| 32 | IR (neat): 2188 (C = N), 1263 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 11H, OCH_2CH_3 , $\text{SCH}(\text{CH}_3)\text{CH}_2\text{CH}_3$), 2.95 (s, 6H, $\text{SO}_2\text{N}(\text{CH}_3)_2$), 3.2~4.5 (m, 7H, SCH_2 , $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2) |

Table 2-12

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 33 | IR (neat): 2176 (C = N), 1266 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.25 (s, 3H, SCH_3), 2.7~3.2 (m, 2H, SCH_2), 3.6~4.5 (m, 6H, $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2), 4.90 (s, 2H, SCH_2N) |
| 34 | IR (neat): 1662 (C = O), 1599 (C = N), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.6~3.2 (m, 2H, SCH_2), 2.91 (s, 3H, NCH_3), 3.6~4.5 (m, 6H, $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2) |
| 35 | IR (neat): 2200 (C = N), 1263 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 11H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$, NCH_2CH_3), 2.6~3.2 (m, 2H, SCH_2), 3.5~4.5 (m, 8H, NCH_2 , $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2) |

Table 2-13

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 36 | IR (neat): 2200 (C = N), 1265 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 13H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$, $\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$), 2.6~3.2 (m, 2H, SCH_2), 3.5~4.5 (m, 8H, NCH_2 , $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2) |
| 37 | IR (neat): 3292 (NH), 2200 (C = N), 1671 (C = O), 1254 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 11H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$, $\text{COOCH}_2\text{CH}_3$), 2.6~3.2 (m, 2H, SCH_2), 3.5~4.5 (m, 8H, $\text{NCH}_2\text{CH}_2\text{N}$, $\text{COOCH}_2\text{CH}_3$, OCH_2), 9.43 (bs, 1H, NH) |
| 38 | IR (neat): 2188 (C = N), 1686 (C = O), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 11H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$, $\text{COOCH}_2\text{CH}_3$), 2.6~3.2 (m, 2H, SCH_2), 3.15 (s, 3H, NCH_3), 3.4~4.5 (m, 8H, $\text{NCH}_2\text{CH}_2\text{N}$, $\text{COOCH}_2\text{-CH}_3$, OCH_2) |

Table 2-14

| Comp. No. | IR Spectra and NMR Spectra |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 39 | IR (neat): 2188 (C ≡ N), 1686 (C=O), 1257 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 14H, OCH ₂ CH ₂ , SCH ₂ CH ₂ , NCH ₂ CH ₂ , COOCH ₂ CH ₂), 2.6~3.2 (m, 2H, SCH ₂), 3.4~4.5 (m, 10H, NCH ₂ CH ₂ N, NCH ₂ , COOCH ₂ CH ₂ , OCH ₃) |
| 10 40 | IR (neat): 2188 (C ≡ N), 1608 (C=N), 1254 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~2.3 (m, 13H, OCH ₂ CH ₂ , SCH ₂ CH ₂ CH ₂ , NCH ₂ CH ₂ CH ₂ C≡NCN), 2.8~4.4 (m, 7H, NCH ₂ CH ₂ CH ₂ C≡NCN, SCH ₂ , OCH ₃) |
| 15 41 | IR (KBr): 2176 (C≡N), 1254 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~2.0 (m, 8H, SCH ₂ CH ₂ CH ₂ CH ₂), 3.32 (s, 3H, NCH ₃), 3.2~3.9 (m, 5H, SCH ₂ , NCH ₂ CH ₂ N), 3.81 (d, 3H, OCH ₃) |
| 20 25 30 35 | Table 2-15 |

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40 42 | IR (KBr): 2176 (C≡N), 1254 (P=O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 1.35 (t, 3H, OCH ₂ CH ₃), 2.40 (d, 3H, SCH ₃), 3.32 (s, 3H, NCH ₃), 3.6~4.5 (m, 6H, N-CH ₂ CH ₂ N, OCH ₂) |
| 45 43 | IR (neat): 2176 (C ≡ N), 1254 (P = O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 1.35 (t, 6H, OCH ₂ CH ₃ , SCH ₂ CH ₃), 2.6~3.2 (m, 2H, SCH ₂), 3.32 (s, 3H, NCH ₃), 3.6~4.5 (m, 6H, NCH ₂ CH ₂ N, OCH ₂) |
| 50 44 | IR (neat): 2176 (C ≡ N), 1260 (P = O) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.9~2.1 (m, 10H, OCH ₂ CH ₃ , SCH ₂ -CH(CH ₃) ₂), 2.7~3.1 (m, 2H, SCH ₂), 3.32 (s, 3H, NCH ₃), 3.6~4.5 (m, 6H, NCH ₂ CH ₂ N, OCH ₂) |

EP 0 464 830 B1

Table 2-16

| 5 | Comp. No. | IR Spectra and NMR Spectra |
|----|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 45 | 45 | IR (neat): 2212 (C = N), 1260 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 14H, OCH_2CH_3 , $\text{SCH}-(\text{CH}_3)\text{CH}_2\text{CH}_3$, $\text{OCH}(\text{CH}_3)\text{CH}_2\text{N}$), 3.2~4.5 (m, 5H, SCH , $\text{OCH}(\text{CH}_3)\text{CH}_2\text{N}$, OCH_2), 4.8~5.4 (m, 1H, $\text{OCH}(\text{CH}_3)\text{CH}_2\text{N}$) |
| 10 | 46 | IR (neat): 2194 (C = N), 1764 (C = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 11H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$, $\text{COOCH}_2\text{CH}_3$), 2.72~3.26 (m, 2H, SCH_2), 3.8~4.5 (m, 8H, $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2 , $\text{COOCH}_2\text{CH}_3$) |
| 15 | 47 | IR (neat): 2182 (C = N), 1260 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.70~3.22 (m, 2H, SCH_2), 3.6~4.5 (m, 6H, $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2), 4.62 (s, 2H, NCH_2CN) |

Table 2-17

| 20 | Comp. No. | IR Spectra and NMR Spectra |
|----|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25 | 48 | IR (neat): 2188 (C = N), 1260 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.6~3.2 (m, 2H, SCH_2), 3.45 (s, 3H, SO_2CH_3), 3.6~4.5 (m, 6H, $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2) |
| 30 | 49 | IR (neat): 2182 (C = N), 1257 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.7~3.2 (m, 2H, SCH_2), 3.35 (s, 3H, OCH_3), 3.4~4.5 (m, 10H, $\text{NCH}_2\text{CH}_2\text{N}$, $\text{OCH}_2\text{CH}_2\text{O}$, OCH_2CH_3), 5.20 (s, 2H, OCH_2N) |

Table 2-18

| 35 | Comp. No. | IR Spectra and NMR Spectra |
|----|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40 | 50 | IR (neat): 2182 (C = N), 1710 (C = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 11H, OCH_2CH_3 , $\text{SCH}-(\text{CH}_3)\text{CH}_2\text{CH}_3$), 3.05 (s, 6H, $\text{N}(\text{CH}_3)_2$), 3.2~4.5 (m, 7H, SCH , $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2) |
| 45 | 51 | IR (neat): 2176 (C = N), 1254 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 16H, OCH_2CH_3 , $\text{SCH}-(\text{CH}_3)\text{CH}_2\text{CH}_3$, $\text{NCH}_2\text{CH}_2\text{CH}_3$), 3.2~4.5 (m, 9H, SCH , $\text{NCH}_2\text{CH}_2\text{N}$, NCH_2 , OCH_2) |
| 50 | 52 | IR (neat): 1563 (C = N), 1248 (P = O) cm^{-1} NMR (CDCl_3), δ (ppm): 0.8~2.0 (m, 8H, OCH_2CH_3 , $\text{SCH}_2\text{-CH}_2\text{CH}_3$), 2.7~4.5 (m, 8H, SCH_2 , $\text{NCH}_2\text{CH}_2\text{N}$, OCH_2), 3.32 (s, 3H, OCH_3), 4.70 (s, 2H, OCH_2N) |

EP 0 464 830 B1

Table 2-19

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | IR (neat): 2206 (C = N), 1560 (C = C) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.0 (m, 11H, OCH ₂ CH ₃ , SCH-(CH ₃)CH ₂ CH ₃), 3.2~4.5 (m, 7H, SCH, NCH ₂ CH ₂ N, OCH ₂), 3.39 (s, 3H, OCH ₃), 5.01 (s, 2H, OCH ₂ N) |
| 10 | IR (neat): 2212 (C = N), 1719 (C = O), 1563 (C = C) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.0 (m, 17H, OCH ₂ CH ₃ , SCH-(CH ₃)CH ₂ CH ₃ , NCOC(CH ₃) ₂), 3.2~3.8 (m, 3H, SCH, CH ₂ C1), 4.0~4.5 (m, 6H, OCH ₂ , NCH ₂ CH ₂ N) |
| 15 | IR (neat): 2176 (C = N), 1722 (C = O), 1617 (C = N) cm ⁻¹ NMR (CDCl ₃), δ(ppm): 0.8~2.1 (m, 8H, OCH ₂ CH ₃ , SCH ₂ -CH ₂ CH ₃), 1.21 (s, 9H, C(CH ₃) ₃), 2.7~4.8 (m, 10H, OCH ₂ , SCH ₂ , NCH ₂ CH ₂ N, NCH ₂ CO) |

Table 2-20

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20 | IR (neat): 2170 (C ≡ N), 1590 (C=N) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~2.2 (m, 10H, OCH ₂ CH ₃ , SCH ₂ -, CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₂ N), 2.6~4.5 (m, 8H, SCH ₂ , OCH ₂ , NCH ₂ CH ₂ CH ₂ N), 3.37 (s, 3H, NCH ₃) |
| 25 | IR (neat): 2188 (C ≡ N), 1608 (C=N), 1257 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~2.4 (m, 10H, OCH ₂ CH ₃ , SCH ₂ -, CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₂ C=NCN), 2.7~3.2 (m, 4H, SCH ₂ , NCH ₂ CH ₂ CH ₂ C=NCN), 3.8~4.5 (m, 4H, OCH ₂ , NCH ₂ CH ₂ C=NCN) |
| 30 | IR (neat): 2188 (C ≡ N), 1605 (C=N), 1257 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~3.4 (m, 16H, OCH ₂ CH ₃ , SCH ₂ -, CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₂ C=NCN), 3.7~4.5 (m, 4H, OCH ₂ , NCH ₂ CH ₂ CHCH ₃ C=NCN) |
| 35 | IR (neat): 2188 (C ≡ N), 1605 (C=N), 1257 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~3.4 (m, 16H, OCH ₂ CH ₃ , SCH ₂ -, CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₂ C=NCN), 3.7~4.5 (m, 4H, OCH ₂ , NCH ₂ CH ₂ CHCH ₃ C=NCN) |
| 40 | IR (neat): 2188 (C ≡ N), 1605 (C=N), 1257 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~3.4 (m, 16H, OCH ₂ CH ₃ , SCH ₂ -, CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₂ C=NCN), 3.7~4.5 (m, 4H, OCH ₂ , NCH ₂ CH ₂ CHCH ₃ C=NCN) |
| 45 | IR (neat): 2188 (C ≡ N), 1605 (C=N), 1257 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~3.4 (m, 16H, OCH ₂ CH ₃ , SCH ₂ -, CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₂ C=NCN), 3.7~4.5 (m, 4H, OCH ₂ , NCH ₂ CH ₂ CHCH ₃ C=NCN) |

Table 2-21

| Comp. No. | IR Spectra and NMR Spectra |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 59 | IR (neat): 1542 (C=N), 1263 (P=O) cm ⁻¹ NMR (CDCl ₃), δ (ppm): 0.8~2.4 (m, 10H, OCH ₂ CH ₃ , SCH ₂ -, CH ₂ CH ₃ , NCH ₂ CH ₂ CH ₂ C=NCN) |

CH_2 , CH_2 , $\text{NCH}_2\text{CH}_2\text{C}=\text{NCN}$), 2.7~3.3 (m, 4H, SCH_2 , $\text{NCH}_2\text{CH}_2\text{C}=\text{NCN}$), 3.7~4.5 (m, 4H, OCH_2 , $\text{NCH}_2\text{CH}_2\text{C}=\text{NCN}$)

60 IR (neat): 2182 (C≡N), 1563 (C=N), 1254 (P=O) cm⁻¹

10 NMR (CDCl₃), δ (ppm): 0.8~2.1 (m, 12H, OCH₂CH₂, SCH₂ -
 - CH₂ CH₂, -NCH₂CH₂ CH₂CH₂C≡NCN), 2.6~3.2 (m, 4H, SCH₂ ,
 - NCH₂CH₂CH₂CH₂C≡NCN), 3.6~4.5 (m, 4H, OCH₂ , -NCH₂CH₂ -
 15 CH₂CH₂C≡NCN)

The compounds of the present invention exhibit excellent activity as active ingredients of insecticides, acaricides and nematocides. The compounds of the present invention are effective for controlling, for instance, agricultural and horticultural pests such as Coleoptera (for instance, Scarabaeidae, Chrysomelidae, Henosepilachna vigintioctopunctata and Lissorhoptrus oryzophilus), Lepidoptera (for instance, Mamestra brassicae, Pieris rapae, Plutera xylostella, Noctuidae, Adoxophyes orana and Chilo suppressalis), Hemiptera (for instance, Delphacidae, Deltoccephalidae, Aleyrodidae, Aphididae and Scales) and Thysanoptera (for instance, Scirtothrips dorsalis and Thrips pulm); Sanitary pests such as Mosquitoes, Flies, Blattidae, Fleas and Lice; Grain pests; cloth and house pests; Plant parasitic nematodes such as root-knot nematodes and root-lesion nematodes; and Plant parasitic mites such as Tetranychus urticae, Tetranychus cinnabarinus, Tetranychus kanzawai and Panonychus citri. They are also effective for controlling soil insect pests. The term "soil insect pest" used herein means, for instance, Gastropoda such as slugs and snails; Isopoda such as Armadillidium vulgare and Sow bugs. In addition, they are likewise effective for controlling insect pests such as Dicofol, organophosphorus compound-resistant plant parasitic mites, organophosphorus compound-resistant Aphididae and Musca domestica.

When the compounds of the present invention are used as active ingredients of insecticidal, acaricidal, nematocidal compositions and compositions for killing or controlling soil pest insects, they may be used as such, but may in general be formed into a variety of formulations together with adjuvants such as emulsifiable concentrates, dusts, wettable powders, liquid formulations, aerosols and pastes like conventional formulations of agricultural chemicals. The formulations in general comprise 0.5 to 90 parts by weight of the active ingredient and 10 to 99.5 parts by weight of an adjuvant. When these formulations are practically used, they can be applied as such or after diluting them with a diluent such as water to a desired concentration.

40 The term "adjuvant" herein means carriers, emulsifying agents, suspending agents, dispersing agents, spreaders, penetrants, wetting agents, thickeners and stabilizers. These adjuvants may, if necessary, be added in an appropriate amount. The carriers can roughly be classified into solid carriers and liquid carriers. Examples of the solid carriers include vegetable and animal powder such as starches, active carbon, 45 soybean flour, wheat flour, wood powder, fish meal and powdered milk; and mineral powders such as talc, kaolin, bentonite, calcium carbonate, zeolite, diatomaceous earth, white carbon, clay, alumina and powdered sulfur. On the other hand, examples of the liquid carriers are water; alcohols such as methyl alcohol and ethylene glycol; ketones such as acetone and methyl ethyl ketone; ethers such as dioxane and tetrahydrofuran; aliphatic hydrocarbons such as kerosine; aromatic hydrocarbons such as xylene, trimethyl- 50 benzene, tetramethylbenzene, cyclohexane and solvent naphtha; halogenated hydrocarbons such as chloroform and chlorobenzene; amides such as dimethylformamide; esters such as ethyl acetate and glycerin esters of fatty acids; nitriles such as acetonitrile; and sulfur atom-containing compounds such as dimethylsulfoxide. If necessary, the compounds of the present invention may be admixed with or used simultaneously with other agricultural chemicals such as insecticides, acaricides, nematocides, bactericides, 55 antiviral agents, attractants, herbicides and plant growth regulators. In admixtures, greater effectiveness may sometimes be attained.

Examples of insecticides, acaricides or nematocides include organophosphorus acid ester compounds such as DDVP, Diazinon, Malathion, Fenitrothion, Prothiofos, Dioxabenzofos and Acephate; carbamate

compounds such as Carbaryl, Propoxur, Oxamyl, Carbofuran and Methomyl; organochlorine compounds such as Dicofol and Tetradifon; organometal compounds such as Cyhexatin and Fenbutatin oxide; pyrethroid compounds such as Fenvalerate, Permethrin, Deltamethrin and Bifenthrin; urea compounds such as Diflubenzuron, Teflubenzuron and Chlorfluazuron; heterocyclic compounds such as Buprofezin and Hexythiazox; and other compounds such as dinitro compounds, organosulfur compounds, amidine compounds and triazine compounds. In addition to the foregoing compounds, the compound of the present invention can also be admixed with or used simultaneously with microbial pesticides such as BT agents and insect pathogen virus pesticides.

Examples of the bactericides are organophosphorus compounds such as Iprobenfos, Edifenphos and Phosethyl-aluminum; organocopper compounds such as oxyquinoline copper, copper terephthalate; organochlorine compounds such as Fthalide and Chlorothalonil; dithiocarbamate compounds such as Maneb, Zineb and Propineb; dicarboximide compounds such as Iprodione, Vinclozolin and Procymidone; azole compounds such as Triadimefon, Bitertanol, Etaconazole, Propiconazole and Penconazole; benzimidazole compounds such as Thiophanate-methyl and Benomyl; carbinal compounds such as Fenarimol and Flutriafol; benzanilide compounds such as Mepronil and Flutolanil; phenylamide compounds such as Metalaxyl and Oxadixyl; and other compounds such as piperazine compounds, quinoxaline compounds, morpholine compounds, anthraquinone compounds, sulfenic acid compounds, crotalic acid compounds, urea compounds and antibiotics.

As has been discussed above, the insecticides, acaricides and nematocides which comprise, as active ingredient, the compounds of the present invention are effective for controlling a variety of deleterious insects, harmful mites, destructive nematodes and harmful soil insect pests. These agricultural chemicals or formulations are applied at a concentration ranging from 1 to 20,000 ppm, desirably 20 to 2,000 ppm expressed in terms of the amount of the active ingredient. The concentration of these active ingredients can be appropriately adjusted depending on various factors such as shapes of the formulations, methods, purposes, time and places of application as well as the condition of infestation of insect pest. For instance, when aquatic insect pests are to be controlled, the insect pest can be controlled by spraying a solution of the compound having a concentration falling within the range defined above and, therefore, the concentration of the active ingredient required for controlling the aquatic insect pest is lower than that defined above. The amount of the agricultural chemicals or formulations to be applied per unit area (per 10 a) ranges from about 0.1 to 5,000 g and preferably 10 to 1,000 g expressed in terms of the amount of the active ingredient, but in a particular case, they may be applied in an amount outside the range defined above.

The application of a variety of formulations or dilute solutions thereof which comprise the compounds of the present invention can be performed according to any manner of application usually adopted, for instance, spraying (such as spraying, dusting, misting, atomizing, granule application and application on water surface); soil applications (such as mixing and drench); surface applications (such as coating, dressing and painting); and poison bait. It is also possible to control the development and growth of harmful insect pests, in particular deleterious insects through the action of excreta obtained by admixing the foregoing active ingredient to feed and giving the feed to domestic animals. Further, they can also be applied in accordance with ultra low volume application. In this method, the chemicals or formulations can comprise 100% active ingredient.

(EXAMPLES)

The method for preparing the compounds of the present invention will hereinafter be explained in more detail with reference to the following Preparation Examples.

Preparation Example 1: O-ethyl-S-n-propyl-(3-ethyl-2-nitroimino-1-imidazolidinyl)phosphonothiolate (Compound No. 2)

2.00 g of O-ethyl-S-n-propyl-(2-nitroimino-1-imidazolidinyl) phosphonothiolate was dissolved in 20 ml of N,N-dimethylformamide and then 0.32 g of a 60% sodium hydride was gradually added to the resulting solution. Thereafter, the solution was cooled down to 0 to 5 °C and 1.27 g of ethyl iodide was gradually added thereto dropwise. After the completion of the dropwise addition, the temperature of the solution was slowly brought back to room temperature and the solution was further stirred for additional 12 hours to complete the reaction. After the reaction, the solution was poured into ice water and extracted with dichloromethane. The dichloromethane phase was washed with water, dried over anhydrous magnesium sulfate, the dichloromethane was distilled off under reduced pressure and the residue obtained was purified by silica gel column chromatography (eluent: ethyl acetate) to give 0.50 g of Compound No. 2 as an oily

substance.

Preparation Example 2: O-ethyl-S-n-propyl-(3-methyl-2-cyanoimino-1-imidazolidinyl)phosphonothiolate (Compound No. 3)

5 To a mixture comprising 0.44 g of a 60% sodium hydride and 50 ml of N,N-dimethylformamide, 1.24 g of 1-methyl-2-cyanoiminoimidazolidine was gradually added. After the mixture was allowed to stand for a brief period, 2.76 g of an 88.2% toluene solution of O-ethyl-S-n-propylphosphorochloride thiolate was gradually dropwise added to the mixture. After the completion of the dropwise addition, the reaction solution
10 was poured into ice water and then extracted with chloroform. The chloroform phase was washed with water, dried over anhydrous magnesium sulfate, the chloroform was distilled off under reduced pressure and the residue obtained was purified by silica gel column chromatography (eluent: chloroform/methanol = 97:3) to give 1.50 g of Compound No. 3 as an oily substance.

15 Preparation Example 3: O-ethyl-S-n-propyl-(2-methanesulfonylimino-1-imidazolidinyl)phosphonothiolate (Compound No. 9)

20 2.0 g of 2-methanesulfonyliminoimidazolidine was dissolved in 20 ml of N,N-dimethylformamide. The resulting solution was cooled down to 0 °C and then 1.02 g of a 60% sodium hydride was gradually added.
20 Thereafter, 3.00 g of an 88.2% toluene solution of O-ethyl-S-n-propylphosphorochloride thiolate was gradually dropwise added to the solution. After the completion of the dropwise addition, the temperature of the reaction solution was slowly brought back to room temperature and further the reaction was continued for additional 12 hours. After the reaction, the reaction solution was poured into ice water, neutralized with a 10% hydrochloric acid solution and then extracted with chloroform. The chloroform phase was washed with water, dried over anhydrous magnesium sulfate, the chloroform was distilled off under reduced pressure and the residue obtained was purified by silica gel column chromatography (eluent: chloroform/methanol = 97:3) to give 2.20 g of Compound No. 9 as an oily substance.

30 Preparation Example 4: O-ethyl-S-sec-butyl-(3-methoxymethyl-2-cyanoimino-1-imidazolidinyl)phosphonothiolate (Compound No. 29)

35 1.50 g of O-ethyl-S-sec-butyl-(2-cyanoimino-1-imidazolidinyl) phosphonothiolate was dissolved in 20 ml of tetrahydrofuran. The resulting solution was cooled and maintained at a temperature of ranging from 0 to 5 °C and 0.25 g of a 60% sodium hydride was gradually added to the solution. After 30 minutes, 0.50 g of chloromethyl methyl ether was dropwise added thereto. After the completion of the dropwise addition, the temperature of the reaction solution was brought back to room temperature and the solution was stirred for additional 3 hours to complete the reaction.

40 After the reaction, the reaction solution was poured into ice water and then extracted with ethyl acetate. The ethyl acetate phase was washed with water, dried over anhydrous magnesium sulfate, the ethyl acetate was distilled off under reduced pressure and the residue obtained was purified by silica gel column chromatography (eluent: chloroform) to thus give 1.10 g of Compound No. 29 as an oily substance.

45 Specific examples of formulations will be described below, but the adjuvants such as carriers and surfactants are by no means limited to those used in the following examples. In the following specific formulations, the term "part" means "part by weight" unless otherwise specified.

45 Formulation Example 1 (Wettable Powder)

50 20 parts of Compound No. 1, 56 parts of acid clay, 15 parts of white carbon, 4 parts of calcium lignin sulfonate and 5 parts of polyoxyethylene alkylphenyl ether were uniformly mixed and pulverized to give a wettable powder.

Formulation Example 2 (Emulsifiable Concentrate)

55 To 20 parts of Compound No. 2, 75 parts of xylene was added. And then, 5 parts of New Calgon ST-20 (available from Takemoto Oil & Fat Co., Ltd.) was added to the resulting solution as an emulsifying agent and then the mixture was mixed and dissolved to give an emulsifiable concentrate.

Formulation Example 3 (Granule)

5 parts of Compound No. 1, 3 parts of calcium lignin sulfonate, one part of sodium dodecylbenzenesulfonate, 30 parts of bentonite and 61 parts of clay were sufficiently pulverized and mixed. The mixture was then sufficiently kneaded while adding water, followed by granulation and drying to thus give a granule.

5 The insecticidal, acaricidal and nematocidal effects of the compounds of the present invention will hereunder be explained with reference to the following Test Examples.

Test Example 1

10 The emulsifiable concentrate obtained by Formulation Example 2 was diluted with water to 500 ppm and 50 ppm and the resulting diluted emulsions were sprayed on leaves of chinese cabbage. After air-drying, the leaves were introduced into a plastic container having a size of 21 cm (height) x 13 cm (width) x 3 cm (depth), then 10 third instar larvae of common cutworm were put on the leaves. The container was 15 then placed in a thermostated room maintained at 26° C. After 2 days, the number of surviving larvae was recorded to obtain the mortality (%) (repeated two times). The results thus obtained are summarized in the following Table 3.

Table 3

| 20 | <u>Compound No.</u> | <u>Concn. of Active Ingredient (ppm)</u> | <u>Mortality (%)</u> |
|----|---------------------|------------------------------------------|----------------------|
| | 2 | 500 | 100 |
| 25 | | 50 | 0 |
| | 3 | 500 | 100 |
| | | 50 | 70 |
| 30 | 4 | 500 | 100 |
| | | 50 | 70 |
| 35 | 5 | 500 | 100 |
| | | 50 | 90 |
| 40 | 6 | 500 | 100 |
| | | 50 | 100 |
| 45 | 7 | 500 | 100 |
| | | 50 | 100 |
| 50 | 9 | 500 | 100 |

EP 0 464 830 B1

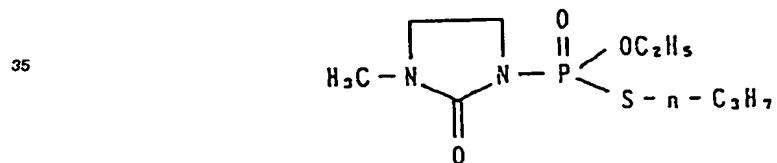
| | | | |
|----|----|-----|-----|
| | | 50 | 80 |
| | 10 | 500 | 100 |
| 5 | | 50 | 0 |
| | 14 | 500 | 100 |
| 10 | | 50 | 100 |
| | 15 | 500 | 100 |
| | | 50 | 90 |
| 15 | 16 | 500 | 100 |
| | | 50 | 20 |
| 20 | 17 | 500 | 100 |
| | | 50 | 60 |
| | 18 | 500 | 100 |
| 25 | | 50 | 100 |
| | 20 | 500 | 100 |
| | | 50 | 90 |
| 30 | 21 | 500 | 100 |
| | | 50 | 0 |
| 35 | 26 | 500 | 100 |
| | | 50 | 10 |
| | 27 | 500 | 100 |
| 40 | | 50 | 0 |
| | 29 | 500 | 100 |
| | | 50 | 20 |
| 45 | 30 | 500 | 100 |
| | | 50 | 100 |
| 50 | 31 | 500 | 100 |

EP 0 464 830 B1

| | | | |
|----|----|-----|-----|
| | | 50 | 50 |
| 5 | 32 | 500 | 100 |
| | | 50 | 10 |
| 10 | 33 | 500 | 100 |
| | | 50 | 70 |
| 15 | 34 | 500 | 100 |
| | | 50 | 100 |
| 20 | 35 | 500 | 100 |
| | | 50 | 80 |
| 25 | 36 | 500 | 100 |
| | | 50 | 20 |
| 30 | 37 | 500 | 100 |
| | | 50 | 90 |
| 35 | 38 | 500 | 100 |
| | | 50 | 50 |
| 40 | 39 | 500 | 100 |
| | | 50 | 40 |
| 45 | 40 | 500 | 100 |
| | | 50 | 0 |
| 50 | 41 | 500 | 100 |
| | | 50 | 100 |
| 55 | 44 | 500 | 100 |
| | | 50 | 90 |
| 60 | 45 | 500 | 100 |
| | | 50 | 90 |
| 65 | 46 | 500 | 100 |

| | | | |
|----|------------------------|-----|-----|
| | | 50 | 100 |
| | 47 | 500 | 100 |
| 5 | | 50 | 50 |
| | 49 | 500 | 100 |
| 10 | | 50 | 0 |
| | 50 | 500 | 100 |
| | | 50 | 10 |
| 15 | 51 | 500 | 100 |
| | | 50 | 50 |
| 20 | 53 | 500 | 100 |
| | | 50 | 10 |
| 25 | Comparative Compound A | 500 | 100 |
| | | 50 | 10 |
| | Untreated | --- | 0 |

30 The Comparative Compound A as set forth in Table 3 is a compound represented by the following structural formula and disclosed in Japanese Unexamined Patent Publication No. Sho 61-267594:



40

Test Example 2

45

The emulsifiable concentrate obtained by Formulation Example 2 was diluted with water to 500 ppm and the seedlings of rice plant were immersed therein for 10 seconds. After air-drying, the seedlings whose roots were wrapped round with absorbent cotton were introduced into a test tube, then 10 second instar larvae of green rice leafhopper were put into the test tube, the opening thereof was closed with gauze. The 50 tube was placed in a thermostated room maintained at 26 ° C. After 2 days, the number of surviving larvae was recorded to obtain the mortality (%) (repeated two times). The results thus obtained are summarized in the following Table 4.

55

Table 4

| <u>Compound No.</u> | <u>Concn. of Active Ingredient (ppm)</u> | <u>Mortality (%)</u> |
|---------------------|------------------------------------------|----------------------|
| 1 | 500 | 100 |
| 3 | 500 | 100 |
| 4 | 500 | 100 |
| 5 | 500 | 100 |
| 9 | 500 | 100 |
| 10 | 500 | 100 |
| 11 | 500 | 100 |
| 14 | 500 | 100 |
| 15 | 500 | 100 |
| 16 | 500 | 100 |
| 17 | 500 | 100 |
| 18 | 500 | 100 |
| 19 | 500 | 100 |
| 20 | 500 | 100 |
| 21 | 500 | 100 |
| 26 | 500 | 100 |
| 27 | 500 | 100 |

40

45

50

55

EP 0 464 830 B1

| | | | |
|----|------------------------|-----|-----|
| | 28 | 500 | 100 |
| | 29 | 500 | 100 |
| 5 | 30 | 500 | 100 |
| | 31 | 500 | 100 |
| 10 | 32 | 500 | 100 |
| | 33 | 500 | 100 |
| | 34 | 500 | 100 |
| 15 | 35 | 500 | 100 |
| | 37 | 500 | 100 |
| 20 | 38 | 500 | 100 |
| | 40 | 500 | 100 |
| | 41 | 500 | 100 |
| 25 | 44 | 500 | 100 |
| | 45 | 500 | 100 |
| 30 | 46 | 500 | 100 |
| | 47 | 500 | 100 |
| | 49 | 500 | 100 |
| 35 | 50 | 500 | 100 |
| | 51 | 500 | 100 |
| 40 | 53 | 500 | 100 |
| | Comparative Compound A | 500 | 100 |
| 45 | Untreated | --- | 0 |

The Comparative Compound A as set forth in Table 4 is the same as that defined above in connection with Table 3.

50 Test Example 3

A kidney bean leaf was cut into 3 x 5 cm². The leaf was put on a filter paper wetted with water for preventing drying of the leaf and 20 female adults of kanzawa spider mite were released on the leaf. After 55 24 hours, 500 ppm and 50 ppm of concentration of active ingredient prepared by diluting with water the emulsifiable concentrate obtained by Formulation Example 2 were sprayed on the leaf. After air-drying, the mites were held in a thermostated room maintained at 26 ° C. After 24 hours, the number of surviving adults was recorded to obtain the mortality (%) (repeated two times). The results thus obtained are

summarized in the following Table 5.

Table 5

| ⁵ Compound No. | <u>Concn. of Active Ingredient (ppm)</u> | <u>Mortality (%)</u> |
|------------------------------|------------------------------------------|----------------------|
| 1 | 500 | 100 |
| 10 | 50 | 0 |
| 2 | 500 | 100 |
| 15 | 50 | 0 |
| 3 | 500 | 100 |
| 20 | 50 | 80 |
| 4 | 500 | 100 |
| 25 | 50 | 20 |
| 5 | 500 | 100 |
| 25 | 50 | 40 |
| 6 | 500 | 100 |
| 30 | 50 | 50 |
| 7 | 500 | 100 |

35

40

45

50

55

EP 0 464 830 B1

| | | | |
|----|----|-----|-----|
| | | 50 | 90 |
| 5 | 9 | 500 | 100 |
| | | 50 | 60 |
| 10 | 10 | 500 | 100 |
| 10 | | 50 | 70 |
| 11 | 11 | 500 | 100 |
| | | 50 | 80 |
| 15 | 12 | 500 | 100 |
| | | 50 | 0 |
| 20 | 14 | 500 | 100 |
| | | 50 | 80 |
| | 15 | 500 | 100 |
| 25 | | 50 | 10 |
| | 16 | 500 | 100 |
| | | 50 | 0 |
| 30 | 17 | 500 | 100 |
| | | 50 | 30 |
| 35 | 18 | 500 | 100 |
| | | 50 | 90 |
| | 19 | 500 | 100 |
| 40 | | 50 | 0 |
| | 20 | 500 | 100 |
| | | 50 | 0 |
| 45 | 26 | 500 | 100 |
| | | 50 | 30 |
| 50 | 27 | 500 | 100 |

EP 0 464 830 B1

| | | | |
|----|----|-----|-----|
| | | 50 | 20 |
| | 28 | 500 | 100 |
| 5 | | 50 | 30 |
| | 29 | 500 | 100 |
| | | 50 | 50 |
| 10 | | 500 | 100 |
| | | 50 | 20 |
| 15 | 31 | 500 | 100 |
| | | 50 | 10 |
| | 32 | 500 | 100 |
| 20 | | 50 | 0 |
| | 33 | 500 | 100 |
| 25 | | 50 | 0 |
| | 34 | 500 | 100 |
| | | 50 | 20 |
| 30 | 35 | 500 | 100 |
| | | 50 | 10 |
| 35 | 36 | 500 | 100 |
| | | 50 | 10 |
| | 37 | 500 | 100 |
| 40 | | 50 | 50 |
| | 38 | 500 | 100 |
| | | 50 | 20 |
| 45 | 39 | 500 | 100 |
| | | 50 | 0 |
| 50 | 40 | 500 | 100 |

EP 0 464 830 B1

| | | | |
|----|-------------------------------|-----|-----|
| | | 50 | 10 |
| 5 | 41 | 500 | 100 |
| | | 50 | 80 |
| 10 | 44 | 500 | 100 |
| | | 50 | 10 |
| 15 | 45 | 500 | 100 |
| | | 50 | 10 |
| 20 | 46 | 500 | 100 |
| | | 50 | 20 |
| 25 | 47 | 500 | 100 |
| | | 50 | 20 |
| | 50 | 500 | 100 |
| | | 50 | 0 |
| 30 | 51 | 500 | 100 |
| | | 50 | 10 |
| 35 | 53 | 500 | 100 |
| | | 50 | 0 |
| 40 | Comparative Compound A | 500 | 100 |
| | | 50 | 10 |
| 45 | Untreated | --- | 0 |

The Comparative Compound A is the same as that defined above in connection with Table 3.

45 **Test Example 4**

To a 1/5,000 are pot, soil contaminated with root-knot nematodes was packed and the soil was admixed with the granules obtained by Formulation Example 3 in an amount of 250 g and 25 g/are expressed in terms of the amount of the active ingredient. Two days after the treatment, seedlings of tomato at 3rd to 4th-leaf stage were transplanted in the soil. Twenty-five days after the transplantation, the degree of the invasion of root-knot nematodes (root-knot index) was determined (repeated two times).

The root-knot index was evaluated on the basis of the following evaluation criteria:

- 55 0 no invasion of root-knot nematodes
- 1 slight invasion of root-knot nematodes
- 2 medium invasion of root-knot nematodes
- 3 severe invasion of root-knot nematodes
- 4 very severe invasion of root-knot nematodes

EP 0 464 830 B1

The results thus obtained are summarized in the following Table 6.

Table 6

| 5 | Compound | Amount of Active Ingredient | <u>Root-Knot Index</u> |
|----|----------|-----------------------------|------------------------|
| | | <u>No.</u> | <u>(g/are)</u> |
| 10 | 1 | 250 | 0 |
| 15 | 2 | 25 | 3 |
| 20 | 250 | 0 | 2 |

25

30

35

40

45

50

55

EP 0 464 830 B1

| | | | |
|----|----|-----|---|
| | 3 | 250 | 0 |
| | | 25 | 0 |
| 5 | 4 | 250 | 0 |
| | | 25 | 0 |
| 10 | 5 | 250 | 0 |
| | | 25 | 1 |
| 15 | 6 | 250 | 0 |
| | | 25 | 3 |
| 20 | 7 | 250 | 0 |
| | | 25 | 1 |
| 25 | 8 | 250 | 0 |
| | | 25 | 2 |
| 30 | 9 | 250 | 0 |
| | | 25 | 0 |
| 35 | 10 | 250 | 0 |
| | | 25 | 2 |
| 40 | 12 | 250 | 0 |
| | | 25 | 3 |
| 45 | 14 | 250 | 0 |
| | | 25 | 0 |
| 50 | 15 | 250 | 0 |
| | | 25 | 0 |
| | 16 | 250 | 0 |
| | | 25 | 1 |
| | 17 | 250 | 0 |
| | | 25 | 0 |

EP 0 464 830 B1

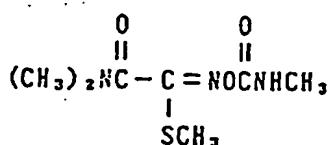
| | | | |
|----|----|-----|---|
| | 18 | 250 | 0 |
| | | 25 | 0 |
| 5 | 20 | 250 | 0 |
| | | 25 | 0 |
| 10 | 21 | 250 | 0 |
| | | 25 | 3 |
| | 25 | 250 | 0 |
| 15 | | 25 | 3 |
| | 26 | 250 | 0 |
| 20 | | 25 | 0 |
| | 27 | 250 | 0 |
| | | 25 | 0 |
| 25 | 29 | 250 | 0 |
| | | 25 | 0 |
| 30 | 30 | 250 | 0 |
| | | 25 | 0 |
| | 31 | 250 | 0 |
| 35 | | 25 | 0 |
| | 33 | 250 | 0 |
| | | 25 | 2 |
| 40 | 34 | 250 | 0 |
| | | 25 | 0 |
| 45 | 35 | 250 | 0 |
| | | 25 | 0 |
| | 36 | 250 | 0 |
| 50 | | 25 | 2 |

EP 0 464 830 B1

| | | | |
|----|----|-----|---|
| | 37 | 250 | 0 |
| | | 25 | 0 |
| 5 | 38 | 250 | 0 |
| | | 25 | 0 |
| 10 | 39 | 250 | 0 |
| | | 25 | 0 |
| 15 | 40 | 250 | 0 |
| | | 25 | 0 |
| 20 | 41 | 250 | 0 |
| | | 25 | 0 |
| 25 | 43 | 250 | 0 |
| | | 25 | 3 |
| 30 | 44 | 250 | 0 |
| | | 25 | 0 |
| 35 | 45 | 250 | 0 |
| | | 25 | 3 |
| 40 | 47 | 250 | 0 |
| | | 25 | 3 |
| 45 | 49 | 250 | 0 |
| | | 25 | 2 |
| 50 | 50 | 250 | 0 |
| | | 25 | 0 |
| 55 | 51 | 250 | 0 |
| | | 25 | 0 |
| 60 | 53 | 250 | 0 |
| | | 25 | 0 |

| | | | |
|----|-------------------------------|------------|----------|
| | 54 | 250 | 0 |
| | 25 | | 1 |
| 5 | Comparative Compound A | 250 | 0 |
| | 25 | | 2 |
| 10 | Comparative Compound B | 250 | 0 |
| | 25 | | 1 |
| 15 | Untreated | --- | 4 |

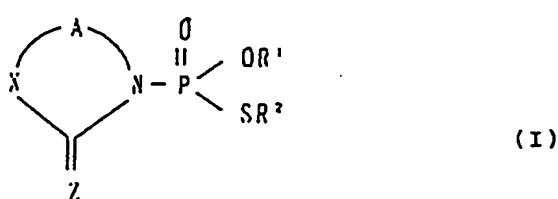
The Comparative Compound A as set forth in Table 6 is the same as that defined above in connection with Table 3 and Comparative Compound B is a compound (oxamyl) represented by the following structural formula:



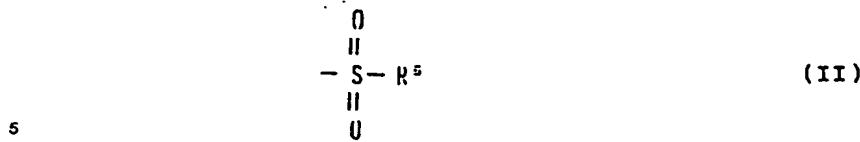
The compounds of the present invention represented by the foregoing general formula (I) exhibit effectiveness in controlling harmful insects, mites and nematodes and thus can be used as novel insecticides, acaricides and nematocides which do not give off a bad or irritating odor and have low toxicity to warm-blooded animals.

Claims

35 1. An organophosphorus compound represented by the following general formula (I):



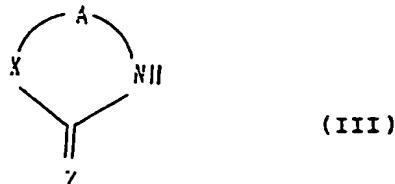
[wherein R¹ and R² each represents a C₁ to C₄ alkyl group; X represents O, S, CH₂, CH-R³ (wherein R³ represents a C₁ to C₃ alkyl group), NH or N-R⁴ (wherein R⁴ represents a C₁ to C₄ alkyl group (the alkyl group may be substituted with at least one group selected from the group consisting of alkoxy, alkylthio, cyano, alkoxyalkyloxy and alkylamino groups and halogen atoms), an alkenyl group which may be substituted with halogen atoms, an alkynyl group which may be substituted with halogen atoms, a phosphoric acid ester radical, a cyano group, a group of the following general formula (III):



(wherein R^5 represents an alkyl or alkylamino group which may be substituted with halogen atoms) or a group represented by the following general formula: $-(\text{R}^6)_n-\text{CO}-\text{R}^7$ (wherein n is 0 or 1; R^6 represents a methylene group which may be substituted with alkyl groups, or an ethylene group which may be substituted with alkyl groups; R^7 represents an alkyl group which may be substituted with halogen atoms, an alkoxy group which may be substituted with halogen atoms, an alkylthio group, an alkylamino group or a hydrogen atom); Z represents a group represented by the general formula: $\text{N}-\text{R}^8$ (R^8 represents a nitro group, a cyano group, an alkylsulfonyl group which may be substituted with halogen atoms, a tosyl group or an alkylcarbonyl group which may be substituted with halogen atoms) or a group represented by the general formula: $\text{C}(\text{CN})\text{R}^9$ (wherein R^9 represents a cyano group or an alkoxy carbonyl group); and A represents an ethylene group which may be substituted with C_1 to C_3 alkyl groups, a trimethylene group which may be substituted with C_1 to C_3 alkyl groups or a group represented by the general formula: $-\text{CH}_2\text{NR}^{10}\text{CH}_2-$ (wherein R^{10} is a C_1 to C_3 alkyl group); and wherein formula (I) according to the present invention specifically excludes organophosphorus compounds of the general formula (I) in which R^1 and R^2 are C_1 to C_4 alkyl groups, X is NH , Z is a cyanoimino group or a nitroimino group and A is an ethylene group which may be substituted with C_1 to C_3 alkyl groups or a trimethylene group which may be substituted with C_1 to C_3 alkyl groups.

- 25 2. The organophosphorus compound according to claim 1 which is O-ethyl-S-n-propyl-(3-methyl-2-cyanoimino-1-imidazolidinyl) phosphonothiolate.
- 30 3. The organophosphorus compound according to claim 1 which is O-ethyl-S-n-propyl-(3-ethyl-2-cyanoimino-1-imidazolidinyl) phosphonothiolate.
- 35 4. The organophosphorus compound according to claim 1 which is O-ethyl-S-n-propyl-(2-dicyanomethylene-1-imidazolidinyl) phosphonothiolate.
- 40 5. The organophosphorus compound according to claim 1 which is O-ethyl-5-n-propyl-(2-methansulfonylimino-1-imidazolidinyl) phosphonothiolate.
- 45 6. The organophosphorus compound according to claim 1 which is O-ethyl-S-sec-butyl(3-methyl-2-cyanoimino-tetrahydropyrimidinyl) phosphonothiolate.
- 50 7. The organophosphorus compound according to claim 1 which is O-ethyl-S-sec-butyl-(3-methyl-2-cyanoimino-1-imidazolidinyl) phosphonothiolate.
- 55 8. The organophosphorus compound according to claim 1 which is O-ethyl-S-n-propyl-(3-methyl-2-dicyanomethylene-1-imidazolidinyl) phosphonothiolate.
- 60 9. The organophosphorus compound according to claim 1 which is O-ethyl-S-sec-butyl-(3-methyl-2-dicyanomethylene-1-imidazolidinyl) phosphonothiolate.
- 65 10. The organophosphorus compound according to claim 1 which is O-ethyl-S-sec-butyl-(3-methoxymethyl-2-cyanoimino-1-imidazolidinyl) phosphonothiolate.
- 70 11. The organophosphorus compound according to claim 1 which is O-ethyl-S-n-propyl- [2-(2-cyano-2-ethoxycarbonylmethylene)-1-imidazolidinyl] -phosphonothiolate.
- 75 12. The organophosphorus compound according to claim 1 which is O-ethyl-S-sec-butyl-1-pyrrolidinyl-phosphonothiolate.

13. A method for preparing an organophosphorus compound as set forth in claim 1 comprising reacting, in the presence of a deacidifying agent, a heterocyclic compound represented by the following general formula (III):



[wherein X represents O, S, CH₂, CH-R³ (wherein R³ represents a C₁ to C₃ alkyl group), NH or N-R⁴ {wherein R⁴ represents a C₁ to C₄ alkyl group (the alkyl group may be substituted with at least one group selected from the group consisting of alkoxy, alkylthio, cyano, alkoxyalkyloxy and alkylamino groups and halogen atoms), an alkenyl group which may be substituted with halogen atoms, an alkynyl group which may be substituted with halogen atoms, a phosphoric acid ester radical, a cyano group, a group of the following general formula (II):

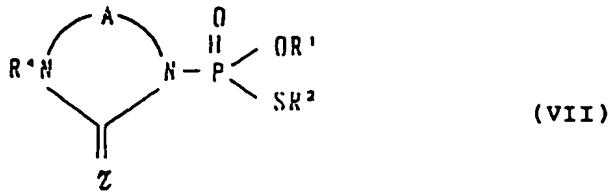


(wherein R⁵ represents an alkyl or alkylamino group which may be substituted with halogen atoms) or a group represented by the following general formula: -(R⁶)_n-CO-R⁷ (wherein n is 0 or 1; R⁶ represents a methylene group which may be substituted with alkyl groups, or an ethylene group which may be substituted with alkyl groups; R⁷ represents an alkyl group which may be substituted with halogen atoms, an alkoxy group which may be substituted with halogen atoms, an alkylthio group, an alkylamino group or a hydrogen atom); Z represents a group represented by the general formula: N-R⁸ (R⁸ represents a nitro group, a cyano group, an alkylsulfonyl group which may be substituted with halogen atoms, a tosyl group or an alkylcarbonyl group which may be substituted with halogen atoms) or a group represented by the general formula: C(CN)R⁹ (wherein R⁹ represents a cyano group or an alkoxy carbonyl group); and A represents an ethylene group which may be substituted with C₁ to C₃ alkyl groups, a trimethylene group which may be substituted with C₁ to C₃ alkyl groups or a group represented by the general formula: -CH₂NR¹⁰CH₂- (wherein R¹⁰ represents a C₁ to C₃ alkyl group)], with a phosphoric acid compound represented by the following general formula (IV):



(wherein R¹ and R² each represents a C₁ to C₄ alkyl group and Hal represents a halogen atom).

50 14. A method for preparing an organophosphorus compound represented by the following general formula (VII):



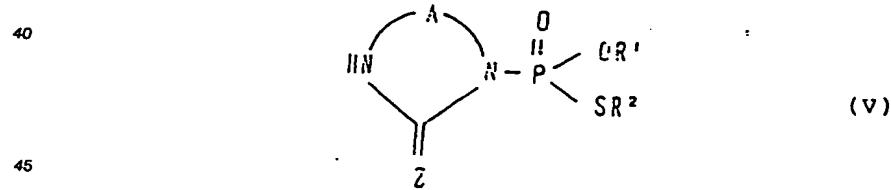
10 [wherein R¹ and R² each represents a C₁ to C₄ alkyl group; R⁴ represents a C₁ to C₄ alkyl group (the alkyl group may be substituted with at least one group selected from the group consisting of alkoxy, alkylthio, cyano, alkoxyalkyloxy and alkylamino groups and halogen atoms), an alkenyl group which may be substituted with halogen atoms, an alkynyl group which may be substituted with halogen atoms, a phosphoric acid ester radical, a cyano group, a group of the following general formula (II):

15



25 (wherein R⁵ represents an alkyl or alkylamino group which may be substituted with halogen atoms) or a group represented by the following general formula: -(R⁶)_n-CO-R⁷ (wherein n is 0 or 1; R⁶ represents a methylene group which may be substituted with alkyl groups, or an ethylene group which may be substituted with alkyl groups; R⁷ represents an alkyl group which may be substituted with halogen atoms, an alkoxy group which may be substituted with halogen atoms, an alkylthio group, an alkylamino group or a hydrogen atom); Z represents a group represented by the general formula: N-R⁸ (R⁸ represents a nitro group, a cyano group, an alkylsulfonyl group which may be substituted with halogen atoms, a tosyl group or an alkylcarbonyl group which may be substituted with halogen atoms) or a group represented by the general formula: C(CN)R⁹ (wherein R⁹ represents a cyano group or an alkoxy carbonyl group); and A represents an ethylene group which may be substituted with C₁ to C₃ alkyl groups, a trimethylene group which may be substituted with C₁ to C₃ alkyl groups or a group represented by the general formula: -CH₂NR¹⁰CH₂- (wherein R¹⁰ is a C₁ to C₃ alkyl group) comprising reacting, in the presence of a deacidifying agent, a compound represented by the following general formula (V):

30



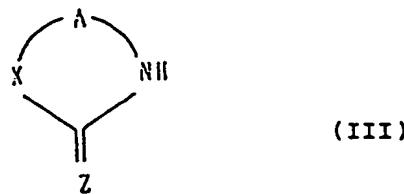
45 (wherein R¹, R², A and Z are the same as those defined above) with a compound represented by the general formula (VI):

50



(wherein R⁴ is the same as that defined above; and Hal represents a halogen atom).

60 15. A method for preparing an organophosphorus compound as set forth in claim 1 comprising reacting, in the presence of a deacidifying agent, a heterocyclic compound represented by the following general formula (III):



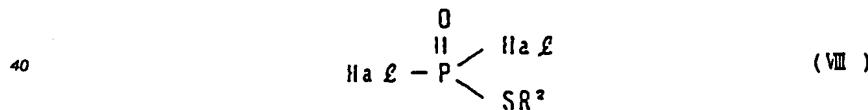
10

[wherein X represents O, S, CH₂, CH-R³ (wherein R³ represents a C₁ to C₃ alkyl group), NH or N-R⁴ {wherein R⁴ represents a C₁ to C₄ alkyl group (the alkyl group may be substituted with at least one group selected from the group consisting of alkoxy, alkylthio, cyano, alkoxyalkyloxy and alkylamino groups and halogen atoms), an alkenyl group which may be substituted with halogen atoms, an alkynyl group which may be substituted with halogen atoms, a phosphoric acid ester radical, a cyano group, a group of the following general formula (II):



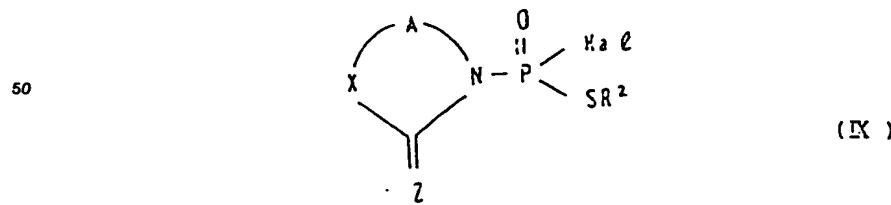
25

(wherein R⁵ represents an alkyl or alkylamino group which may be substituted with halogen atoms) or a group represented by the following general formula: -(R⁶)_n-CO-R⁷ (wherein n is 0 or 1; R⁶ represents a methylene group which may be substituted with alkyl groups, or an ethylene group which may be substituted with alkyl groups; R⁷ represents an alkyl group which may be substituted with halogen atoms, an alkoxy group which may be substituted with halogen atoms, an alkylthio group, an alkylamino group or a hydrogen atom}); Z represents a group represented by the general formula: N-R⁸ (R⁸ represents a nitro group, a cyano group, an alkylsulfonyl group which may be substituted with halogen atoms, a tosyl group or an alkylcarbonyl group which may be substituted with halogen atoms) or a group represented by the general formula: C(CN)R⁹ (wherein R⁹ represents a cyano group or an alkoxy carbonyl group); and A represents an ethylene group which may be substituted with C₁ to C₃ alkyl groups, a trimethylene group which may be substituted with C₁ to C₃ alkyl groups or a group represented by the general formula: -CH₂N¹⁰CH₂- (wherein R¹⁰ is a C₁ to C₃ alkyl group)], with a phosphoric acid compound represented by the following general formula (VIII):



45

(wherein R² represents a C₁ to C₄ alkyl group and Hal represents a halogen atom) to obtain a compound represented by the following general formula (IX):



55

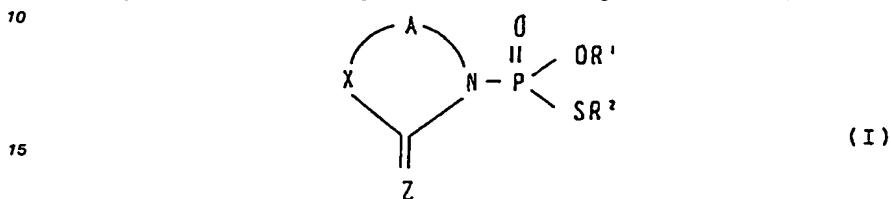
(wherein R², X, Z, A and Hal are the same as those defined above), and further reacting the compound (IX) with a compound represented by the general formula (X): R¹-OH (wherein R¹ is a C₁ to C₄ alkyl

group).

16. An insectidical, acaricidal or nematicidal composition comprising an appropriate carrier and, as an active ingredient, an organophosphorus compound represented by the general formula, (I) according to
5 any one of claims 1 to 12.

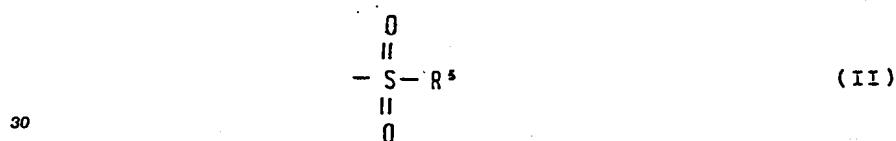
Patentansprüche

1. Organophosphorverbindung der nachstehenden allgemeinen Formel (I):



20 [wobei R¹ und R² jeweils einen C₁- bis C₄-Alkylrest darstellen; X O, S, CH₂, CH-R³ (wobei R³ einen C₁- bis C₃-Alkylrest darstellt), NH oder N-R⁴ darstellt {wobei R⁴ einen C₁- bis C₄-Alkylrest (wobei der Alkylrest mit mindestens einer Gruppe, ausgewählt aus Alkoxy-, Alkylthio-, Cyano-, Alkoxyalkyloxy- und Alkylaminoresten und Halogenatomen, substituiert sein kann), einen Alkenylrest, der mit Halogenatomen substituiert sein kann, einen Alkinylrest, der mit Halogenatomen substituiert sein kann, einen Phosphorsäureesterrest, einen Cyanorest, einen Rest der nachstehenden allgemeinen Formel (II):

25



35 (wobei R⁵ einen Alkyl- oder Alkylaminorest, der mit Halogenatomen substituiert sein kann) oder einen Rest der nachstehenden allgemeinen Formel: -(R⁶)_n-CO-R⁷ darstellt (wobei n 0 oder 1 ist; R⁶ einen Methylenrest, der mit Alkylresten substituiert sein kann, oder einen Ethylenrest, der mit Alkylresten substituiert sein kann, darstellt; R⁷ einen Alkylrest, der mit Halogenatomen substituiert sein kann, einen Alkoxyrest, der mit Halogenatomen substituiert sein kann, einen Alkylthiorest, einen Alkylaminorest oder ein Wasserstoffatom darstellt}); Z einen Rest der allgemeinen Formel: N-R⁸ (wobei R⁸ einen Nitrorest, einen Cyanorest, einen Alkylsulfonylrest, der mit Halogenatomen substituiert sein kann, einen Tosylrest oder einen Alkylcarbonylrest, der mit Halogenatomen substituiert sein kann, darstellt) oder einen Rest der allgemeinen Formel: C(CN)R⁹ darstellt (wobei R⁹ einen Cyanorest oder einen Alkoxy carbonylrest darstellt); und A einen Ethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, einen Trimethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, oder einen Rest der allgemeinen Formel: -CH₂NR¹⁰CH₂- darstellt (wobei R¹⁰ ein C₁- bis C₃-Alkylrest ist); und wobei die erfindungsgemäße Formel (I) Phosphorverbindungen der allgemeinen Formel (I) ausschließt, bei denen R¹ und R² C₁- bis C₄-Alkylreste sind, X NH ist, Z ein Cyaniminorest oder ein Nitroiminorest ist und A ein Ethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, oder ein Trimethylenrest ist, der mit C₁- bis C₃-Alkylresten substituiert sein kann.

50 2. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-n-propyl-(3-methyl-2-cyanimino-1-imidazolidinyl)phosphonothiolat ist.

3. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-n-propyl-(3-ethyl-2-cyanimino-1-imidazolidinyl)phosphonothiolat ist.

55 4. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-n-propyl-(2-dicyanomethylen-1-imidazolidinyl)phosphonothiolat ist.

5. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-n-propyl-(2-methansulfonylimino-1-imidazolidinyl)phosphonothiolat ist.

6. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-sek-butyl-(3-methyl-2-cyanimino-tetrahydropyrimidinyl)phosphonothiolat ist.

7. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-sek-butyl-(3-methyl-2-cyanimino-1-imidazolidinyl)phosphonothiolat ist.

10 8. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-n-propyl-(3-methyl-2-dicyanomethylen-1-imidazolidinyl)phosphonothiolat ist.

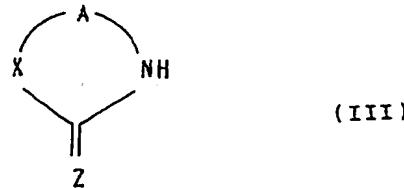
9. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-sek-butyl-(3-methyl-2-dicyanomethylen-1-imidazolidinyl)phosphonothiolat ist.

15 10. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-sek-butyl-(3-methoxymethyl-2-cyanimino-1-imidazolidinyl)phosphonothiolat ist.

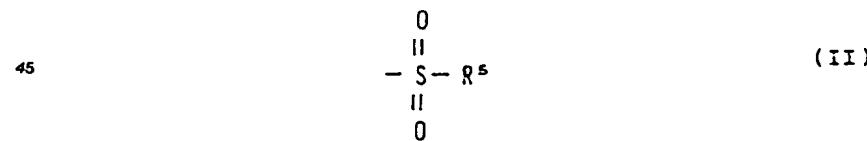
20 11. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-n-propyl-[2-(2-cyano-2-ethoxycarbonylmethylen)-1-imidazolidinyl]phosphonothiolat ist.

12. Organophosphorverbindung nach Anspruch 1, die O-Ethyl-S-sek-butyl-1-pyrrolidinyl-phosphonothiolat ist.

25 13. Verfahren zur Herstellung einer Organophosphorverbindung, wie in Anspruch 1 beschrieben, umfassend das Umsetzen, in Anwesenheit eines Entsäuerungsmittels, einer heterozyklischen Verbindung der nachstehenden allgemeinen Formel (III):



[wobei X O, S, CH₂, CH-R³ (wobei R³ einen C₁- bis C₃-Alkylrest darstellt), NH oder N-R⁴ darstellt (wobei R⁴ einen C₁- bis C₄-Alkylrest (wobei der Alkylrest mit mindestens einer Gruppe, ausgewählt aus Alkoxy-, Alkylthio-, Cyano-, Alkoxyalkyloxy- und Alkylaminoresten und Halogenatomen, substituiert sein kann), einen Alkenylrest, der mit Halogenatomen substituiert sein kann, einen Alkinylrest, der mit Halogenatomen substituiert sein kann, einen Phosphorsäureesterrest, einen Cyanorest, einen Rest der nachstehenden allgemeinen Formel (II):



50 (wobei R⁵ einen Alkyl- oder Alkylaminorest, der mit Halogenatomen substituiert sein kann) oder einen Rest der nachstehenden allgemeinen Formel: -(R⁶)_n-CO-R⁷ darstellt (wobei n 0 oder 1 ist; R⁶ einen Methylenrest, der mit Alkylresten substituiert sein kann, oder einen Ethylenrest, der mit Alkylresten substituiert sein kann, darstellt; R⁷ einen Alkylrest, der mit Halogenatomen substituiert sein kann, einen Alkoxyrest, der mit Halogenatomen substituiert sein kann, einen Alkylthiorest, einen Alkylaminorest oder ein Wasserstoffatom darstellt); Z einen Rest der allgemeinen Formel: N-R⁸ (wobei R⁸ einen Nitrorest, einen Cyanorest, einen Alkylsulfonylrest, der mit Halogenatomen substituiert sein kann, einen Tosylrest oder einen Alkylcarbonylrest, der mit Halogenatomen substituiert sein kann, darstellt) oder einen Rest der allgemeinen Formel: C(CN)R⁹ darstellt (wobei R⁹ einen Cyanorest oder einen Alkoxy carbonylrest

darstellt); und A einen Ethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, einen Trimethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, oder einen Rest der allgemeinen Formel: -CH₂NR¹⁰CH₂- darstellt (wobei R¹⁰ einen C₁- bis C₃-Alkylrest darstellt), mit einer Phosphorsäureverbindung der nachstehenden allgemeinen Formel (IV):

5



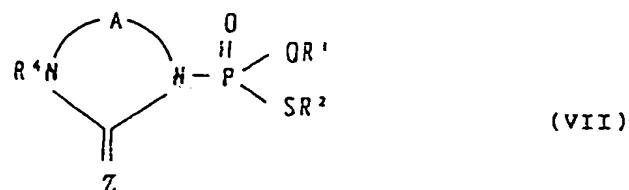
10

(wobei R¹ und R² jeweils einen C₁- bis C₄-Alkylrest darstellen und Hal ein Halogenatom darstellt).

15

14. Verfahren zur Herstellung einer Organophosphorverbindung der nachstehenden allgemeinen Formel (VII):

20



25

[wobei R¹ und R² jeweils einen C₁- bis C₄-Alkylrest darstellen; R⁴ einen C₁- bis C₄-Alkylrest (wobei der Alkylrest mit mindestens einer Gruppe, ausgewählt aus Alkoxy-, Alkylthio-, Cyano-, Alkoxyalkyloxy- und Alkylaminoresten und Halogenatomen, substituiert sein kann), einen Alkenylrest, der mit Halogenatomen substituiert sein kann, einen Alkinylrest, der mit Halogenatomen substituiert sein kann, einen Phosphorsäureesterrest, einen Cyanorest, einen Rest der nachstehenden allgemeinen Formel (II):

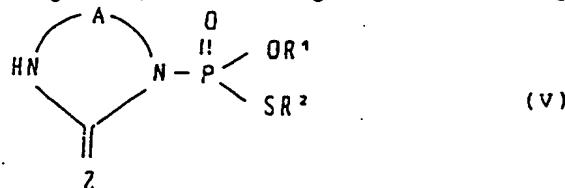
30



35

(wobei R⁵ einen Alkyl- oder Alkylaminorest, der mit Halogenatomen substituiert sein kann) oder einen Rest der nachstehenden allgemeinen Formel: -(R⁶)_n-CO-R⁷ darstellt (wobei n 0 oder 1 ist; R⁶ einen Methylenrest, der mit Alkylresten substituiert sein kann, oder einen Ethylenrest, der mit Alkylresten substituiert sein kann, darstellt; R⁷ einen Alkylrest, der mit Halogenatomen substituiert sein kann, einen Alkoxyrest, der mit Halogenatomen substituiert sein kann, einen Alkylthiorest, einen Alkylaminorest oder ein Wasserstoffatom darstellt); Z einen Rest der allgemeinen Formel: N-R⁸ (wobei R⁸ einen Nitrorest, einen Cyanorest, einen Alkylsulfonylrest, der mit Halogenatomen substituiert sein kann, einen Tosylrest oder einen Alkylcarbonylrest, der mit Halogenatomen substituiert sein kann, darstellt) oder einen Rest der allgemeinen Formel: C(CN)R⁹ darstellt (wobei R⁹ einen Cyanorest oder einen Alkoxy carbonylrest darstellt); und A einen Ethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, einen Trimethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, oder einen Rest der allgemeinen Formel: -CH₂NR¹⁰CH₂- darstellt (wobei R¹⁰ ein C₁- bis C₃-Alkylrest ist)], umfassend das Umsetzen, in Gegenwart eines Entsäuerungsmittels, einer Verbindung der nachstehenden allgemeinen Formel (V):

50



55

EP 0 464 830 B1

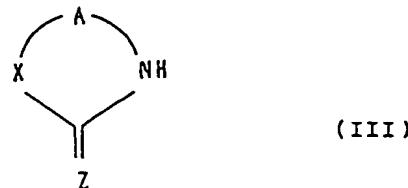
(wobei R¹, R², A und Z wie oben definiert sind) mit einer Verbindung der allgemeinen Formel (VI):

R⁴-Hal (VI)

5 (wobei R⁴ wie oben definiert ist und Hal ein Halogenatom darstellt).

15. Verfahren zur Herstellung einer Organophosphorverbindung, wie in Anspruch 1 beschrieben, umfassend das Umsetzen, in Gegenwart eines Entsäuerungsmittels, einer heterozyklischen Verbindung der nachstehenden allgemeinen Formel (III):

10



15

[wobei X O, S, CH₂, CH-R³, (wobei R³ einen C₁- bis C₃-Alkylrest darstellt), NH oder N-R⁴ darstellt
 20 {wobei R⁴ einen C₁- bis C₄-Alkylrest (wobei der Alkylrest mit mindestens einer Gruppe, ausgewählt aus Alkoxy-, Alkylthio-, Cyanoo-, Alkoxyalkyloxy- und Alkylaminoresten und Halogenatomen, substituiert sein kann), einen Alkenylrest, der mit Halogenatomen substituiert sein kann, einen Alkinylrest, der mit Halogenatomen substituiert sein kann, einen Phosphorsäureesterrest, einen Cyanorest, einen Rest der nachstehenden allgemeinen Formel (II):

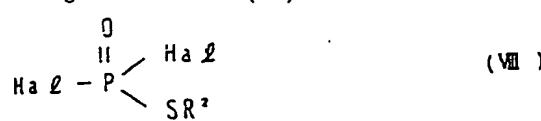
25



30

(wobei R⁵ einen Alkyl- oder Alkylaminorest, der mit Halogenatomen substituiert sein kann) oder einen Rest der nachstehenden allgemeinen Formel: -(R⁶)_n-CO-R⁷ darstellt (wobei n 0 oder 1 ist; R⁶ einen Methylenrest, der mit Alkylresten substituiert sein kann, oder einen Ethylenrest, der mit Alkylresten substituiert sein kann, darstellt; R⁷ einen Alkylrest, der mit Halogenatomen substituiert sein kann, einen Alkoxyrest, der mit Halogenatomen substituiert sein kann, einen Alkylthiorest, einen Alkylaminorest oder ein Wasserstoffatom darstellt); Z einen Rest der allgemeinen Formel: N-R⁸ (wobei R⁸ einen Nitrorest, einen Cyanorest, einen Alkylsulfonylrest, der mit Halogenatomen substituiert sein kann, einen Tosylrest oder einen Alkylcarbonylrest, der mit Halogenatomen substituiert sein kann, darstellt) oder einen Rest der allgemeinen Formel: C(CN)R⁹ darstellt (wobei R⁹ einen Cyanorest oder einen Alkoxy carbonylrest darstellt); und A einen Ethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, einen Trimethylenrest, der mit C₁- bis C₃-Alkylresten substituiert sein kann, oder einen Rest der allgemeinen Formel: -CH₂NR¹⁰CH₂- darstellt (wobei R¹⁰ ein C₁- bis C₃-Alkylrest ist), mit einer Phosphorsäureverbindung der nachstehenden allgemeinen Formel (VIII):

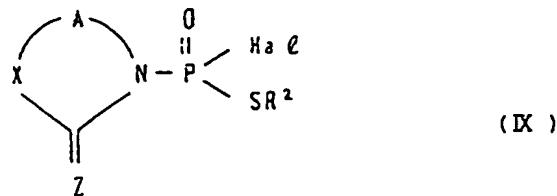
45



50

(wobei R² einen C₁- bis C₄-Alkylrest darstellt und Hal ein Halogenatom darstellt), zu einer Verbindung der nachstehenden allgemeinen Formel (IX):

55

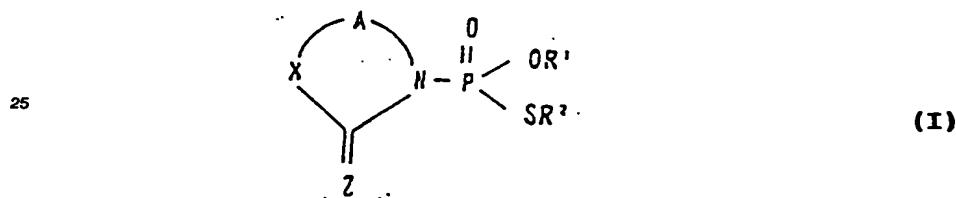


10 (wobei R², X, Z, A und Hal wie vorstehend definiert sind) und weitere Umsetzung der Verbindung (IX) mit einer Verbindung der allgemeinen Formel (X): R¹-OH (wobei R¹ ein C₁- bis C₄-Alkylrest ist).

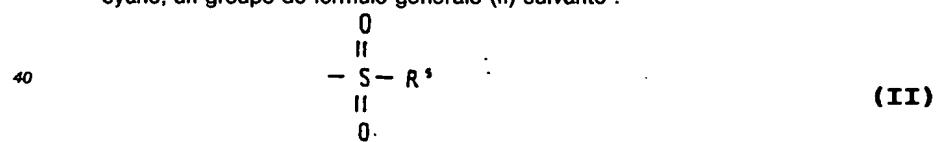
15 16. Insektizid-, Akarizid- oder Nematozid-Zusammensetzung, umfassend einen geeigneten Träger und, als aktiven Inhaltsstoff, eine Organophosphorverbindung der allgemeinen Formel (I), nach einem der Ansprüche 1 bis 12.

Revendications

20 1. Composé organophosphoré représenté par la formule générale (I) suivante :



30 [dans laquelle R¹ et R² représentent chacun un groupe alkyle en C₁ à C₄ ; X représente O, S, CH₂, CH-R³ (où R³ représente un groupe alkyle en C₁ à C₃), NH ou N-R⁴ {où R⁴ représente un groupe alkyle en C₁ à C₄ (le groupe alkyle peut être substitué avec au moins un groupe choisi dans le groupe constitué par les groupes alcoxy, alkylthio, cyano, alcoxyalkyloxy et alkylamino et les atomes d'halogène), un groupe alcényle qui peut être substitué avec des atomes d'halogène, un groupe alcyne qui peut être substitué avec des atomes d'halogène, un radical ester d'acide phosphorique, un groupe cyano, un groupe de formule générale (II) suivante :



40 45 (dans laquelle R⁵ représente un groupe alkyle ou alkylamino qui peut être substitué avec des atomes d'halogène) ou un groupe représenté par la formule générale suivante : -(R⁶)_n-CO-R⁷ (dans laquelle n est 0 ou 1 ; R⁶ représente un groupe méthylène qui peut être substitué avec des groupes alkyle ou un groupe éthylène qui peut être substitué avec des groupes alkyle ; R⁷ représente un groupe alkyle qui peut être substitué avec des atomes d'halogène, un groupe alcoxy qui peut être substitué avec des atomes d'halogène, un groupe alkylthio, un groupe alkylamino ou un atome d'hydrogène)} ; Z représente un groupe représenté par la formule générale : N-R⁸ (R⁸ représente un groupe nitro, un groupe cyano, un groupe alkylsulfonyle qui peut être substitué avec des atomes d'halogène, un groupe tosyle ou un groupe alkylcarbonyle qui peut être substitué avec des atomes d'halogène) ou un groupe représenté par la formule générale : C(CN)R⁹ (dans laquelle R⁹ représente un groupe cyano ou un groupe alcoxycarbonyle) ; et A représente un groupe éthylène qui peut être substitué avec des groupes alkyle en C₁ à C₃, un groupe triméthylène qui peut être substitué avec des groupes alkyle en C₁ à C₃ ou un groupe représenté par la formule générale : -CH₂NR¹⁰CH₂- (dans laquelle R¹⁰ est un groupe alkyle en C₁ à C₃) ; et où la formule (I) selon la présente invention exclut spécifiquement les

composés organophosphorés de formule générale (I) dans laquelle R¹ et R² sont des groupes alkyle en C₁ à C₄, X est NH, Z est un groupe cyano-imino ou un groupe nitro-imino et A est un groupe éthylène qui peut être substitué avec des groupes alkyle en C₁ à C₃ ou un groupe triméthylène qui peut être substitué avec des groupes alkyle en C₁ à C₃.

5 2. Composé organophosphoré selon la revendication 1, qui est le (3-méthyl-2-cyano-imino-1-imidazolidinyl)phosphonothiolate d'O-éthyle et de S-n-propyle.

10 3. Composé organophosphoré selon la revendication 1, qui est le (3-éthyl-2-cyano-imino-1-imidazolidinyl)-phosphonothiolate d'O-éthyle et de S-n-propyle.

15 4. Composé organophosphoré selon la revendication 1, qui est le (2-dicyanométhylène-1-imidazolidinyl)-phosphonothiolate d'O-éthyle et de S-n-propyle.

20 5. Composé organophosphoré selon la revendication 1, qui est le (2-méthanesulfonylimino-1-imidazolidinyl)phosphonothiolate d'O-éthyle et de S-n-propyle.

25 6. Composé organophosphoré selon la revendication 1, qui est le (3-méthyl-2-cyano-imino-tétrahydropyrimidinyl)phosphonothiolate d'O-éthyle et de S-sec-butyle.

30 7. Composé organophosphoré selon la revendication 1, qui est le (3-méthyl-2-cyano-imino-1-imidazolidinyl)phosphonothiolate d'O-éthyle et de S-sec-butyle.

35 8. Composé organophosphoré selon la revendication 1, qui est le (3-méthyl-2-dicyanométhylène-1-imidazolidinyl)phosphonothiolate d'O-éthyle et de S-n-propyle.

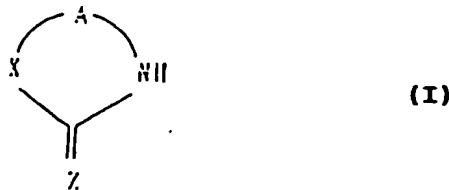
40 9. Composé organophosphoré selon la revendication 1, qui est le (3-méthyl-2-dicyanométhylène-1-imidazolidinyl)phosphonothiolate d'O-éthyle et de S-sec-butyle.

45 10. Composé organophosphoré selon la revendication 1, qui est le (3-méthoxyméthyl-2-cyano-imino-1-imidazolidinyl)phosphonothiolate d'O-éthyle et de S-sec-butyle.

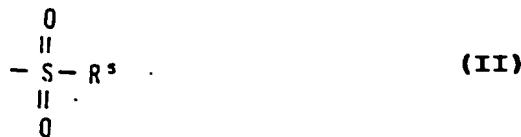
50 11. Composé organophosphoré selon la revendication 1, qui est le [2-(2-cyano-2-éthoxycarbonylméthylène)-1-imidazolidinyl] phosphonothiolate d'O-éthyle et de S-n-propyle.

55 12. Composé organophosphoré selon la revendication 1, qui est le 1-pyrrolidinyl-phosphonothiolate d'O-éthyle et de S-sec-butyle.

40 13. Procédé pour préparer un composé organophosphoré selon la revendication 1, comprenant la réaction, en présence d'un agent désacidifiant, d'un composé hétérocyclique représenté par la formule générale (III) suivante :



50 [dans laquelle X représente O, S, CH₂, CH-R³ (où R³ représente un groupe alkyle en C₁ à C₃), NH ou N-R⁴ (où R⁴ représente un groupe alkyle en C₁ à C₄ (le groupe alkyle peut être substitué avec au moins un groupe choisi dans le groupe constitué par les groupes alcoxy, alkylthio, cyano, alcoxyalkyloxy et alkylamino et les atomes d'halogène), un groupe alcényle qui peut être substitué avec des atomes d'halogène, un groupe alcyne qui peut être substitué avec des atomes d'halogène, un radical ester d'acide phosphorique, un groupe cyano, un groupe de formule générale (II) suivante :

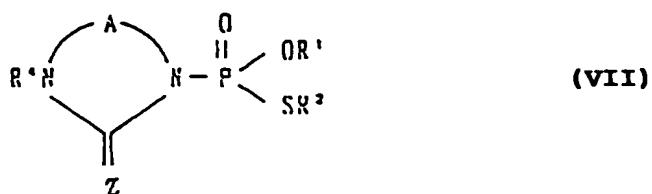


(dans laquelle R⁵ représente un groupe alkyle ou alkylamino qui peut être substitué avec des atomes d'halogène) ou un groupe représenté par la formule générale suivante : -(R⁶)_n-CO-R⁷ (dans laquelle n est 0 ou 1 ; R⁶ représente un groupe méthylène qui peut être substitué avec des groupes alkyle ou un groupe éthylène qui peut être substitué avec des groupes alkyle R⁷ représente un groupe alkyle qui peut être substitué avec des atomes d'halogène, un groupe alcoxy qui peut être substitué avec des atomes d'halogène, un groupe alkylthio, un groupe alkylamino ou un atome d'hydrogène}) ; Z représente un groupe représenté par la formule générale : N-R⁸ (R⁸ représente un groupe nitro, un groupe cyano, un groupe alkylsulfonyle qui peut être substitué avec des atomes d'halogène, un groupe tosyle ou un groupe alkylcarbonyle qui peut être substitué avec des atomes d'halogène) ou un groupe représenté par la formule générale : C(CN)R⁹ (dans laquelle R⁹ représente un groupe cyano ou un groupe alcoxycarbonyle) ; et A représente un groupe éthylène qui peut être substitué avec des groupes alkyle en C₁ à C₃, un groupe triméthylène qui peut être substitué avec des groupes alkyle en C₁ à C₃ ou un groupe représenté par la formule générale : -CH₂NR¹⁰CH₂- (dans laquelle R¹⁰ représente un groupe alkyle en C₁ à C₃), avec un dérivé d'acide phosphorique représenté par la formule générale (IV) suivante :

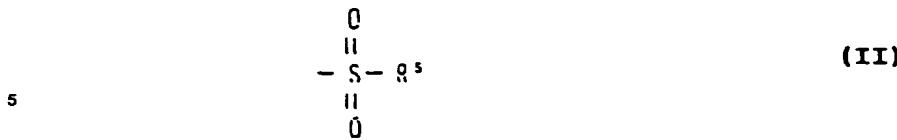


30 (dans laquelle R¹ et R² représentent chacun un groupe alkyle en C₁ à C₄ et Hal représente un atome d'halogène)

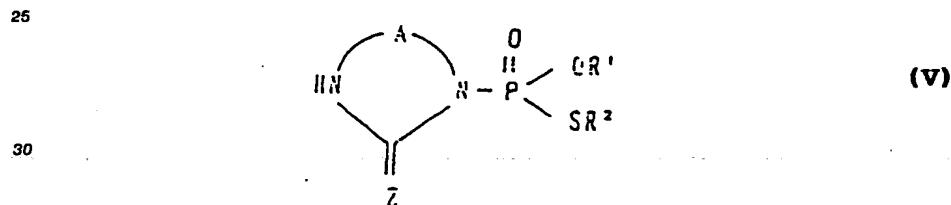
14. Procédé pour préparer un composé organophosphoré représenté par la formule générale (VII) suivante



[dans laquelle R¹ et R² représentent chacun un groupe alkyle en C₁ à C₄ ; R⁴ représente un groupe alkyle en C₁ à C₄ (le groupe alkyle peut être substitué avec au moins un groupe choisi dans le groupe constitué par les groupes alcoxy, alkylthio, cyano, alcoxyalkyloxy et alkylamino et les atomes d'halogène), un groupe alcényle qui peut être substitué avec des atomes d'halogène, un groupe alcyne qui peut être substitué avec des atomes d'halogène, un radical ester d'acide phosphorique, un groupe cyano, un groupe de formule générale (II) suivante :



10 (dans laquelle R^5 représente un groupe alkyle ou alkylamino qui peut être substitué avec des atomes d'halogène) ou un groupe représenté par la formule générale suivante : $-(\text{R}^6)_n\text{CO-R}^7$ (dans laquelle n est 0 ou 1 ; R^6 représente un groupe méthylène qui peut être substitué avec des groupes alkyle ou un groupe éthylène qui peut être substitué avec des groupes alkyle ; R^7 représente un groupe alkyle qui peut être substitué avec des atomes d'halogène, un groupe alcoxy qui peut être substitué avec des atomes d'halogène, un groupe alkylthio, un groupe alkylamino ou un atome d'hydrogène) ; Z représente un groupe représenté par la formule générale : $\text{N}-\text{R}^8$ (R^8 représente un groupe nitro, un groupe cyano, un groupe alkylsulfonyle qui peut être substitué avec des atomes d'halogène, un groupe tosyle ou un groupe alkylcarbonyle qui peut être substitué avec des atomes d'halogène) ou un groupe représenté par la formule générale : $\text{C}(\text{CN})\text{R}^9$ (dans laquelle R^9 représente un groupe cyano ou un groupe alcoxycarbonyle) ; et A représente un groupe éthylène qui peut être substitué avec des groupes alkyle en C_1 à C_3 , un groupe triméthylène qui peut être substitué avec des groupes alkyle en C_1 à C_3 ou un groupe représenté par la formule générale : $-\text{CH}_2\text{NR}^{10}\text{CH}_2-$ (dans laquelle R^{10} est un groupe alkyle en C_1 à C_3), comprenant la réaction, en présence d'un agent désacidifiant, d'un composé représenté par la formule générale (V) suivante :

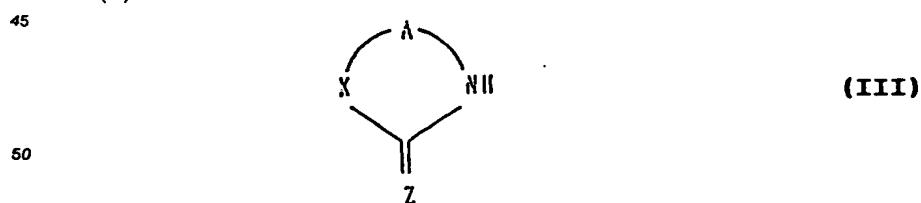


35 (dans laquelle R^1 , R^2 , A et Z sont tels que définis ci-dessus) avec un composé représenté par la formule générale (VI) :



40 (dans laquelle R^4 est tel que défini ci-dessus ; et Hal représente un atome d'halogène).

45 15. Procédé pour préparer un composé organophosphoré selon la revendication 1, comprenant la réaction, en présence d'un agent désacidifiant, d'un composé hétérocyclique représenté par la formule générale (III) suivante :



55 (dans laquelle X représente O, S, CH_2 , $\text{CH}-\text{R}^3$ (où R^3 représente un groupe alkyle en C_1 à C_3), NH ou $\text{N}-\text{R}^4$ (où R^4 représente un groupe alkyle en C_1 à C_4 (le groupe alkyle peut être substitué avec au moins un groupe choisi dans le groupe constitué par les groupes alcoxy, alkylthio, cyano, alcoxyalkyloxy et alkylamino et les atomes d'halogène), un groupe alcényle qui peut être substitué avec des

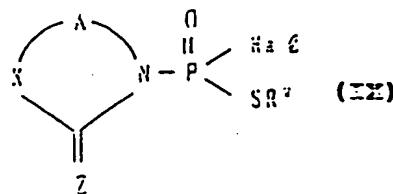
5 atomes d'halogène, un groupe alcynyle qui peut être substitué avec des atomes d'halogène, un radical ester d'acide phosphorique, un groupe cyano, un groupe de formule générale (II) suivante :



10 (dans laquelle R^5 représente un groupe alkyle ou alkylamino qui peut être substitué avec des atomes d'halogène) ou un groupe représenté par la formule générale suivante : $-(\text{R}^6)_n\text{CO-R}^7$ (dans laquelle n est 0 ou 1 ; R^6 représente un groupe méthylène qui peut être substitué avec des groupes alkyle ou un groupe éthylène qui peut être substitué avec des groupes alkyle ; R^7 représente un groupe alkyle qui peut être substitué avec des atomes d'halogène, un groupe alcoxy qui peut être substitué avec des atomes d'halogène, un groupe alkylthio, un groupe alkylamino ou un atome d'hydrogène) ; Z représente un groupe représenté par la formule générale : $\text{N}-\text{R}^8$ (R^8 représente un groupe nitro, un groupe cyano, un groupe alkylsulfonyl qui peut être substitué avec des atomes d'halogène, un groupe tosyle ou un groupe alkylcarbonyl qui peut être substitué avec des atomes d'halogène) ou un groupe représenté par la formule générale : $\text{C}(\text{CN})\text{R}^9$ (dans laquelle R^9 représente un groupe cyano ou un groupe alcooxycarbonyl) ; et A représente un groupe éthylène qui peut être substitué avec des groupes alkyle en C_1 à C_3 , un groupe triméthylène qui peut être substitué avec des groupes alkyle en C_1 à C_3 ou un groupe représenté par la formule générale : $-\text{CH}_2\text{NR}^{10}\text{CH}_2-$ (dans laquelle R^{10} est un groupe alkyle en C_1 à C_3), avec un dérivé d'acide phosphorique représenté par la formule générale (VIII) suivante :



30 (dans laquelle R^2 représente un groupe alkyle en C_1 à C_4 et Hal représente un atome d'halogène), pour obtenir un composé représenté par la formule générale (IX) suivante :



45 (dans laquelle R^2 , X , Z , A et Hal sont tels que définis ci-dessus) et de plus la réaction du composé (IX) avec un composé représenté par la formule générale (X) : $\text{R}^1\text{-OH}$ (dans laquelle R^1 est un groupe alkyle en C_1 à C_4).

50 16. Composition insecticide, acaricide ou nématicide comprenant un support approprié et, en tant qu'ingrédient actif, un composé organophosphoré représenté par la formule générale (I) selon l'une quelconque des revendications 1 à 12.